AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 12, No. 14. WEEKLY. | NEW YORK, THURSDAY, APRIL 4, 1889. | $2.50 per Annum. SINGLE COPIES 5 CENTS

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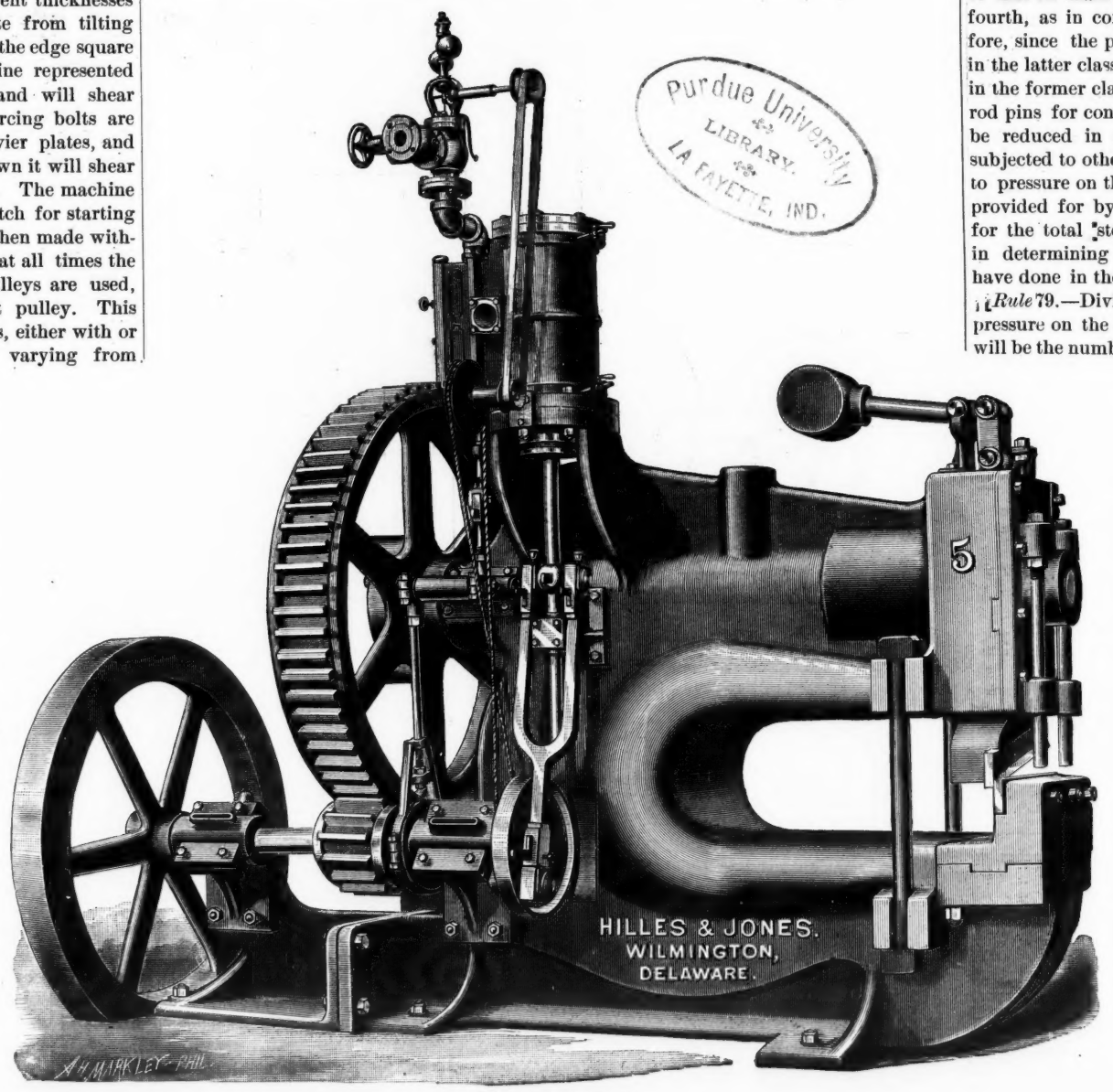
Monitor Shear—Bending Rolls for Making Pipe.

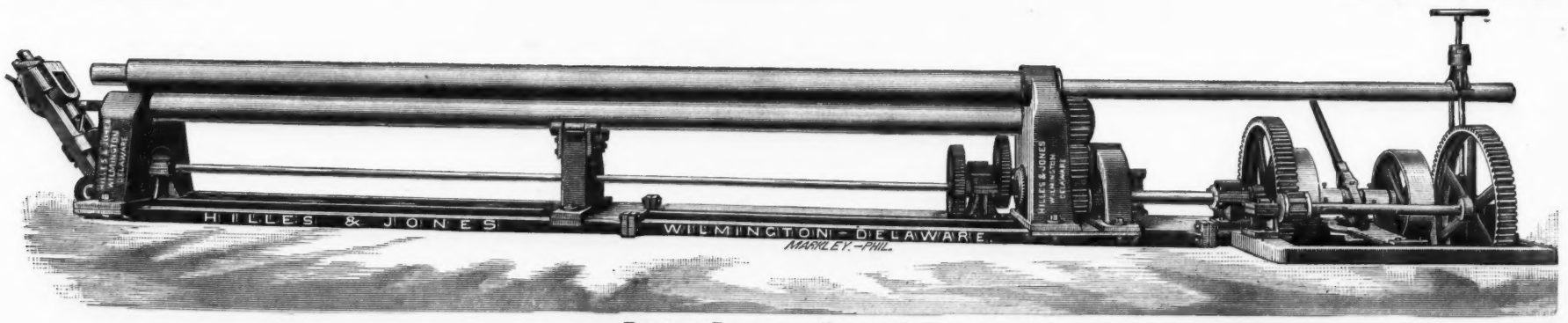
The shear shown on this page is especially designed for shearing heavy plates in plate rolling mills or boiler shops where heavy marine work is done. The holding-down bolts are adjustable for different thicknesses of plate, and prevent the plate from tilting while being trimmed, leaving the edge square with the surface. The machine represented by cut is 42″ in the throat, and will shear 1½″ steel plates. The reinforcing bolts are only used when shearing heavier plates, and when they are in place as shown it will shear 1¼″ plate, 12″ from the edge. The machine is made with or without a clutch for starting and stopping the knives. When made without a clutch, the knives run at all times the engine is running—or, if pulleys are used, whenever the belt is on tight pulley. This machine is made in three sizes, either with or without engine, the weight varying from 20,000 lbs. to 35,000 lbs.

The bending rolls, also shown on this page, were designed with reference to the great demand for pipe of large diameter and in long length for natural gas, oil, etc., which demand calls for special labor-saving tools to get out the pipe rapidly. The machine is calculated for bending the iron while hot. It will be seen by the cut that it is but the work of a moment to drop the housing, take the pipe off, and be ready for another plate. The machine can be handled very quickly; being driven by patent friction pulleys, it is stopped or reversed instantly. The top roll is raised and lowered by power which is entirely independent of the other gearing. The machine, as represented, will take in pipe 20 ft. in length and 9″ and larger in diameter; weight 27,000 lbs. The same general principles of construction are employed for other sizes, and for special requirements.

The manufacturers of these machines are Hilles & Jones, Wilmington, Del.



MONITOR SHEAR.



BENDING ROLLS FOR MAKING PIPE.

It is proposed to substitute electric welding for riveting, in the manufacture of boilers.

Modern Locomotive Construction.

BY J. G. A. MEYER.

EIGHTY-EIGHTH PAPER.

In our last paper we have seen that the side rod pins for eight-wheeled passenger engines are larger than those for mogul and ten-wheeled engines. If, now, we compare the relative pressures on the side rod pins in mogul and consolidation engines, we will find that for the latter class of engines we may make the side rod pins still smaller; that is, say, they may be made smaller than those in mogul engines. The reason for this will be seen by referring to Fig. 488 (page 2), which shows the arrangements of the driving wheels on one side of a consolidation engine. The main rod pin is marked *M*, and *A*, *B*, *D*, are the side rod pins. For the purpose of comparison, we may assume that in all locomotives the total weight on the drivers is equally distributed on the wheels; and we may also assume that the whole pressure on the main rod crank-pin journal is required for turning the wheels (this, of course, is not exactly true.) Under these conditions it will require one-fourth of the pressure on the main crank-pin journal to turn each wheel. In mogul engines we have only three driving wheels on each side of the engine; and with cylinders of the same size as those in a consolidation engine, and also equal steam pressures, the thrust on the main rod crank-pin journal will practically be the same in both engines; and the pressure on the side rod pins for mogul engines will be equal to one-third of that on main rod journal instead of one-fourth, as in consolidation engines. Therefore, since the pressure on the side rod pins in the latter class of engines is less than that in the former classes, it follows that the side rod pins for consolidation engines may also be reduced in size. True, these pins are subjected to other pressures besides that due to pressure on the piston; but these may be provided for by choosing a proper divisor for the total steam pressure on the piston in determining the projected area, as we have done in the following rule:

Rule 79.—Divide the total maximum steam pressure on the piston by 3,200; the quotient will be the number of square inches in the projected area of any one of the side rod pins *A*, *B*, *D* (Fig. 488) made of steel for consolidation engines.

The length and diameter of these pins are equal, or nearly so, in the majority of engines of this class; hence the following rule:

Rule 80.—To find the length and diameter of steel side rod pins for consolidation engines, extract the square root of the projected area as found by Rule 79; this square root will be the length of the pin; if this length contains fractions less than ⅛ inch, then adopt the nearest value divisible by ⅛ of an inch. For the diameter, add to the length found ⅛ of an inch for wear; the sum will be the required diameter.

Example 109.—Find the dimensions of the side rod pins for a consolidation engine having cylinders 20 inches diameter; maximum steam pressure on the piston 130 pounds per square inch.

The area of a piston 20 inches diameter is 314.16 square inches; hence the total maximum steam pressure on the piston will be $314.16 \times 130 = 40840.8$ pounds. According to Rule 79 we have $\frac{40840.8}{3200} = 12.76$ square inches, which is the projected area of the pin.

The square root of 12.76 is 3.57. Hence, the length of the side rod pin will be 3½ inches, and its diameter will be 3⅝ inches.

The dimensions given in the following tables have been computed by the foregoing rules.

There is a possibility, when a consolidation engine is running over an uneven track, causing the wheels to run out of alignment, that the side rod pin *B* will be subjected to a greater pressure than the side rod pins *A* and *D*. Consequently, we frequently find the side rod pin *B* made from ¼ to ⅜ of an inch larger in diameter than that of the pins *A* and *D*. This is good practice, but not a universal one, as in many engines all the side rod pins are the same size. In computing the dimensions given in the foregoing tables, we have assumed all the side rod pins to be equal in size. Should it be desirable to increase the size of the pin *B*, its diameter only should be increased, the length should remain as given; by so doing the center lines of the side rods can be kept more readily in the same vertical plane, which is of great importance.

We have seen that in eight-wheeled passenger engines (two driving wheels on each side) the diameter of the wheel fit of the side rod pin is equal to that of the main pin. In ten-wheeled, mogul, and consolidation engines, the diameter of the wheel fit of the side rod pins is less than that of the main pin; it is generally from ¼ to ½ inch greater than the diameter of the journal. The wheel fit for the main pin should never be less than the diameter of the journal next to the wheels; in fact, it is better practice to increase it from ⅛ to ¼ of an inch.

TABLE P.

Dimensions of steel side rod pins for consolidation engines. Maximum steam pressure on the piston 120 pounds per square inch.

Diameter of Cylinder.	Diameter of Journal.	Length of Journal.
14	2⅛ inches.	2⅜ inches.
15	2⅜ "	2½ "
16	2⅝ "	2¾ "
17	3 "	2⅞ "
18	3⅛ "	3 "
19	3⅜ "	3¼ "
20	3⅝ "	3½ "
21	3¾ "	3⅝ "
22	3⅞ "	3¾ "

TABLE Q.

Dimensions of steel side rod pins for consolidation engines. Maximum steam pressure on the piston 130 pounds per square inch.

Diameter of Cylinder.	Diameter of Journal.	Length of Journal.
14	2⅝ inches.	2⅛ inches.
15	2¾ "	2⅜ "
16	3 "	2⅝ "
17	3⅛ "	3 "
18	3⅜ "	3¼ "
19	3½ "	3⅜ "
20	3⅝ "	3½ "
21	3⅞ "	3⅝ "
22	4⅛ "	4 "

TABLE R.

Dimensions of steel side rod pins for consolidation engines. Maximum steam pressure on the piston 140 pounds per square inch.

Diameter of Cylinder.	Diameter of Journal.	Length of Journal.
14	2⅝ inches.	2⅛ inches.
15	2⅞ "	2¾ "
16	3⅛ "	3 "
17	3¼ "	3⅛ "
18	3½ "	3⅜ "
19	3⅝ "	3½ "
20	3¾ "	3⅝ "
21	4 "	3⅞ "
22	4¼ "	4⅛ "

TABLE S.

Dimensions of steel side rod pins for consolidation engines. Maximum steam pressure on the piston 150 pounds per square inch.

Diameter of Cylinder.	Diameter of Journal.	Length of Journal.
14	2¾ inches.	2⅝ inches.
15	3 "	2⅞ "
16	3⅛ "	3 "
17	3⅜ "	3¼ "
18	3⅝ "	3½ "
19	3¾ "	3⅝ "
20	4 "	3⅞ "
21	4⅛ "	4 "
22	4⅜ "	4¼ "

TABLE T.

Dimensions of steel side rod pins for consolidation engines. Maximum steam pressure on the piston 160 pounds per square inch.

Diameter of Cylinder.	Diameter of Journal.	Length of Journal.
14	2⅞ inches.	2¾ inches.
15	3⅛ "	3 "
16	3¼ "	3⅛ "
17	3½ "	3⅜ "
18	3⅝ "	3½ "
19	3⅞ "	3¾ "
20	4⅛ "	4 "
21	4¼ "	4⅛ "
22	4½ "	4⅜ "

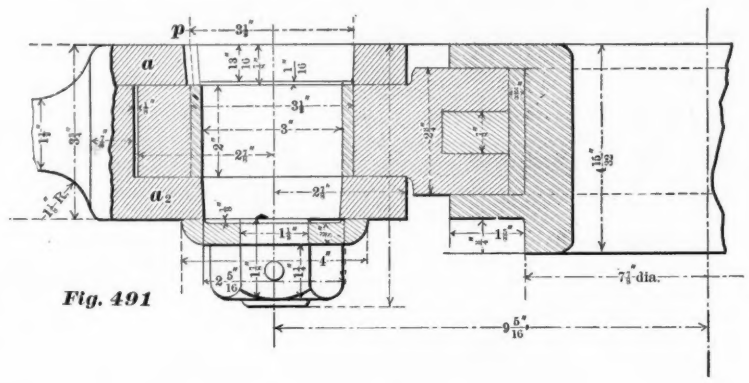


Fig. 491

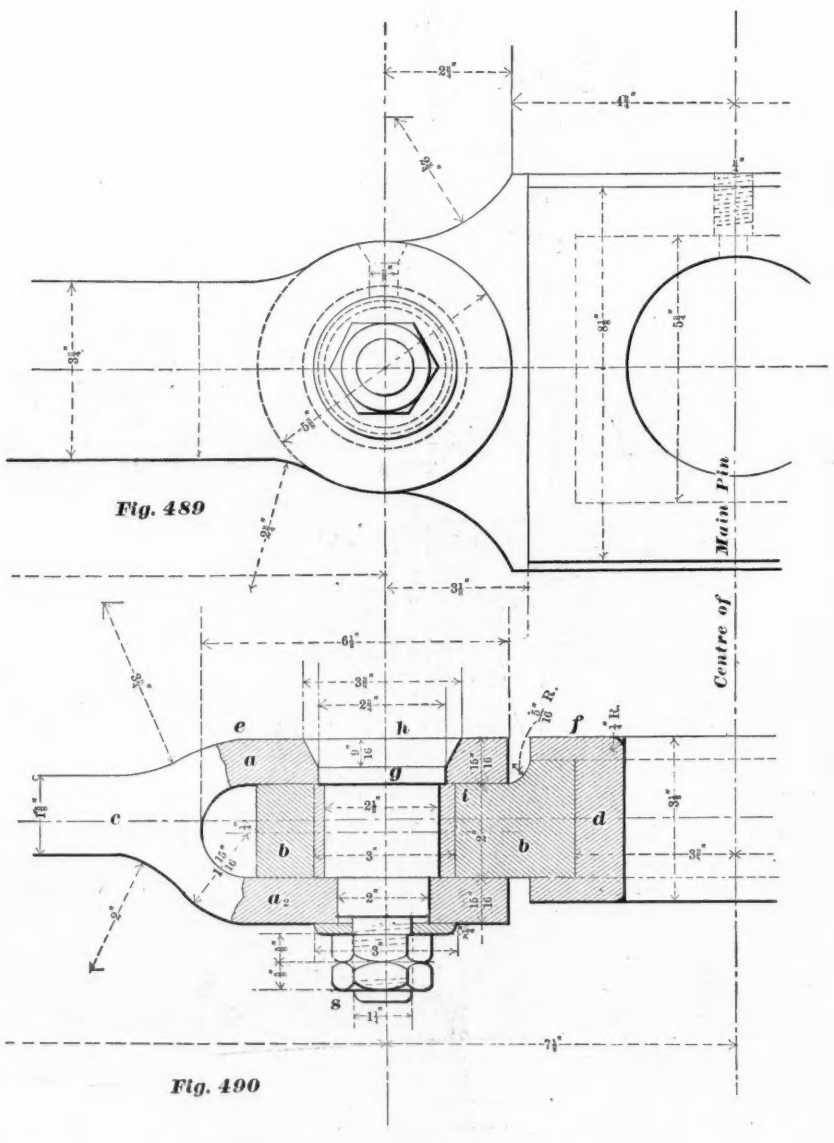


Fig. 490

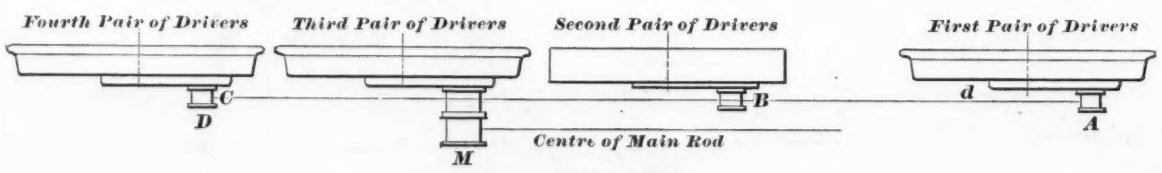


Fig. 488

Modern Locomotive Construction.—See Page 1.

The side rods, in all locomotives which have more than two driving wheels on each side, have a knuckle joint; its form, in many engines, is similar to that shown in Figs. 489 and 490. In mogul and ten-wheeled engines there is only one knuckle joint on each side of engine; sometimes it is placed in the rear of the main pin, as shown in Fig. 437 (73d paper), and occasionally we find it placed in front of the main pin; there is an advantage in placing it in the rear, see 73d paper. In all consolidation engines one knuckle joint is placed in the rear of the main pin and another one in front of the side rod pin *B* (Fig. 488), or in general they are placed in the rear of and close to the pins in the third pair of drivers; and in the front of and close to the pins in the second pair of drivers. The solid ends *b b* of the knuckle joint is generally forged to the central side rod straps, and the forked end is generally forged to the front and rear side rods.

The center lines of the side rods always lie in one vertical plane, represented by the line *c d* in Fig. 488. This plane is also represented by the line *c d* in Fig. 490. In this figure it will be noticed that the center line *b b* of the knuckle joint does not coincide with the center line *c d* of the side rods; the reason for this is, that in a great number of engines the inner face *f* of the flange of the main rod brass is close to the outer face of the hub of wheel, consequently the inner face *e* of the knuckle joint must not project beyond the face *f*, and therefore the center *b b* of the forked end will often be out of line with center *c d* of the rod.

The form of the pin through the knuckle joint is plainly shown in Fig. 490. A larger portion of its head is made conical, and the remainder, *g*, cylindrical; the diameter of this cylindrical portion is generally a little greater than the diameter of the body of the pin, so that the latter can be passed easily through the hole bored for the head. Another form of the knuckle joint pin is shown in Fig. 491; here the holes in both wings aa_2 of the forked end are reamed out with one tapered reamer; this plan seems to be the most popular one.

The ratio between the length and the diameter of the pin, as made by different builders, varies somewhat, as will be seen by referring to Figs. 490 and 491; but we believe good results will be obtained by making the diameter 25 per cent. greater than the length of the pin.

The Proposed London Central Railway.

A week or two ago the opponents of this railway held a meeting, at which resolutions were passed condemnatory of the scheme. Those who are anxious that the proposed subway should be constructed, held a counter meeting last week, at which some of the features of the line were explained by its projector, Colonel R. R. Hazard. The line is to run under the roadway between the curbs, at a depth of 12 feet, on a solid concrete bottom 2 feet in thickness. The outer walls are to be of brick, and 2 feet thick. It is intended to construct four tracks of the standard gauge of 4 feet 8½ inches, separated by steel partitions, and the side galleries are to be utilized in many ways, notably for the accommodation of water and gas pipes, telephone wires, pneumatic tubes, etc. Express and slow trains, worked and lighted by electricity, are to be run at intervals of two minutes on the respective tracks. It is estimated that the cost of the line will be £750,000, and that it will take only six months to complete. At present six stations have been arranged for, the railway running from the top of St. James' street, Piccadilly, passing along Shaftesbury avenue, through Broad street to High Holborn, and terminating at Holborn Circus, the distance being 1¼ mile. This portion, however, is to be only the beginning of a network of such subways. Owing to the moderate depth of the tunnel below the roadway, and the substantial nature of the structure, there is not much fear of danger being done to adjoining property, so that that objection will probably fall to the ground. But the fight with vested interests, as pointed out before by us, will be a tough one, nevertheless.—*Iron* (London).

Interesting Appliances in One Boiler Room.

By C. L. Redfield.

Last summer I had occasion to make a visit to a boiler room located in the basement of a large business block. There were two boilers, 54x14″, which, with their setting, occupied nearly one-third of the whole room. Although both boilers were in operation and the weather outside was quite hot, I found the room no hotter than it was outside—in fact, quite comfortable—and that, too, without any apparent draft blowing through. Having seen a good many boiler rooms that were much easier to keep cool than this, yet which were insufferably hot, I was naturally surprised, and asked the cause of it. I found that the whole secret lay in the manner of supplying the draft to the furnace, which was the practical application of a hint that I had myself dropped to the engineer some time before, but which I had at that time entirely forgotten.

As every one knows, the heated air in any room naturally rises to the ceiling, and in a boiler room the upper part is very much the

hottest, because it is there that the heating is done by radiation from the upper part of the boiler and the steam pipes. Ordinarily the air for the furnace is taken in at the floor, the very coolest place in the whole room, and, as a consequence, the heated air remains to make every one uncomfortable. "In this case the engineer had built a brick flue on the side of the boiler setting, one end of which opened over the top of the boiler and the other into the ash-pit, as shown in Fig. 1. It was through this flue, which had a damper in it, that the entire draft for the fire was taken, the front ash-pit doors and draft holes being closed tightly. It is true that there was a patent forced draft appliance situated in the short horizontal flue into the ash-pit, which was put automatically into operation whenever the steam pressure fell more than one-half pound below a certain standard, but as this was seldom in operation, and it is not part of the object of this article to puff a patented improvement, will pass over that entirely.

The advantages of supplying a draft in this manner are twofold: First, it keeps the room comfortable by drawing off the hottest part of the air, leaving only that which is comparatively cool; and second, it is economical, because it saves the heat radiated from the boiler and steam pipes, by conveying it in the form of heated air to the furnace. The economy of supplying heated air under a boiler is something more than simply the saving of the amount of heat imparted to the air before it is admitted. Air that is already hot will bring about more perfect combustion than will air that is cold. It seems as if a device as simple as this, which accomplishes so much for economy and comfort, ought to come into very general use.

This engineer had a cleanly disposition, and disliked dust flying around, especially as he had a pair of elevator engines in the same room. To prevent dust and ashes flying around when he cleaned the fire, or performed any other operation that would raise a dust, he put on the sheet-iron flue, shown to the left of the boiler in Fig. 2. This flue was open below, except for the slide damper shown, and connected with the stack above. When raking the fire he would open the damper, which would create a strong draft up the flue, carrying all flying dust and ashes with it. Here again an important double purpose was accomplished. Not only did this strong draft carry out the dust and ashes, but the very existence of this draft into the stack prevented the flow of a large body of cold air along the bottom of the boiler—a thing not only objectionable because it carries off a large amount of heat, but because it chills the plates which were but an instant before exposed to the intense action of the fire. How much injury is done to the sheets by this sudden change from hot to cold and back to hot again is unknown, but all agree that it is certainly not a benefit. The damper in the flue was invariably kept closed, except when the furnace doors were open. This damper could, of course, be used to check the draft if desired, but as the one in the flue leading to the ash-pit had perfect control, it was never so used.

This engineer, besides being cleanly, was lazy. Not that kind of laziness that shirks work that should be done, but that kind that seriously objects to doing laboriously by hand those things that could be better and more quickly done by some mechanical appliance. In other words, like the fellow whose legs never saw his body abused, he never allowed his brain to let his muscles get unnecessarily weary.

His coal bins in front of his boiler extended under the sidewalk, and through the hole above he delivered the ashes to the cart that hauled them away. A very little experience in having them hauled up in a bucket, by means of a rope, and having half of them dumped down on his head by the man above letting the bucket catch under the edge of the hole, satisfied him that he wanted something better. He therefore got some gas-pipe and constructed the hydraulic elevator, shown in Fig. 3. The cylinder was made of a piece of 5-inch pipe, with a cap below and a stuffing-box above, bored to fit a piece of turned 4-inch pipe. The cylinder was sunk in the ground directly under the hole in the sidewalk, and was tapped for a ¾-inch pipe, which separated into two branches above the floor. One of these was attached to the city water supply and the other discharged into the sewer. Each was supplied with a globe valve at a convenient place.

The piston or plunger was made of 4-inch pipe, carefully turned, and fitted with a plug below and a cap above. Before closing up the ends it was filled with sand, so as to give it the necessary weight to lower rapidly. The only guide for the plunger was the stuffing-box, which was made long on purpose.

The plunger was prevented from being thrown out by having the plank, which was fastened to the cap on top, too large to pass through the hole in the sidewalk. As the area of the piston was nearly 16 square inches, it will be seen that a pressure of 40 pounds on the city water mains enabled him to lift between 500 and 600 pounds if occasion required. This made a cheap lift, always ready for use, and it saved a good deal of hard, disagreeable work.

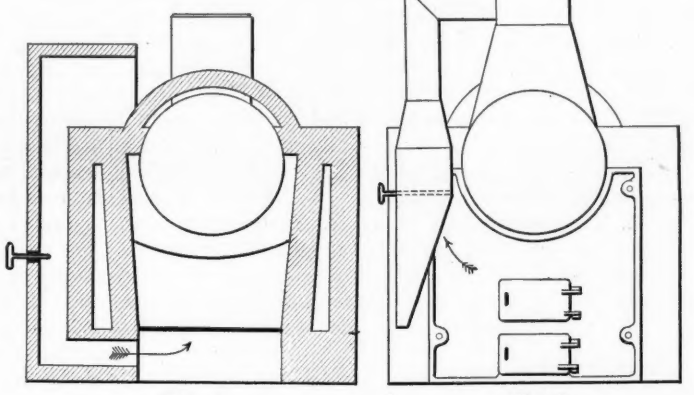


Fig. 1

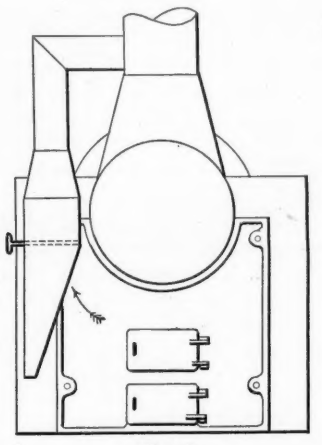


Fig. 2

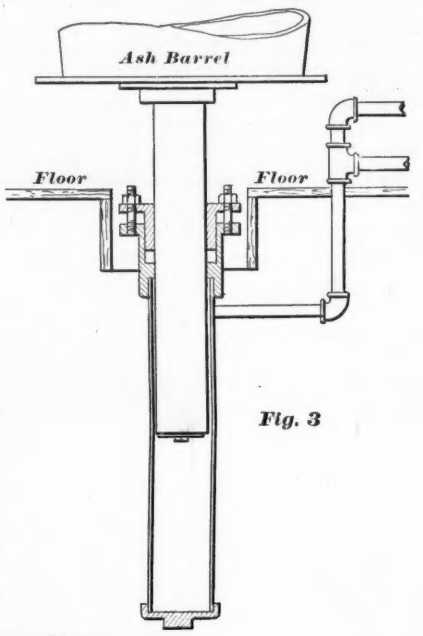


Fig. 3

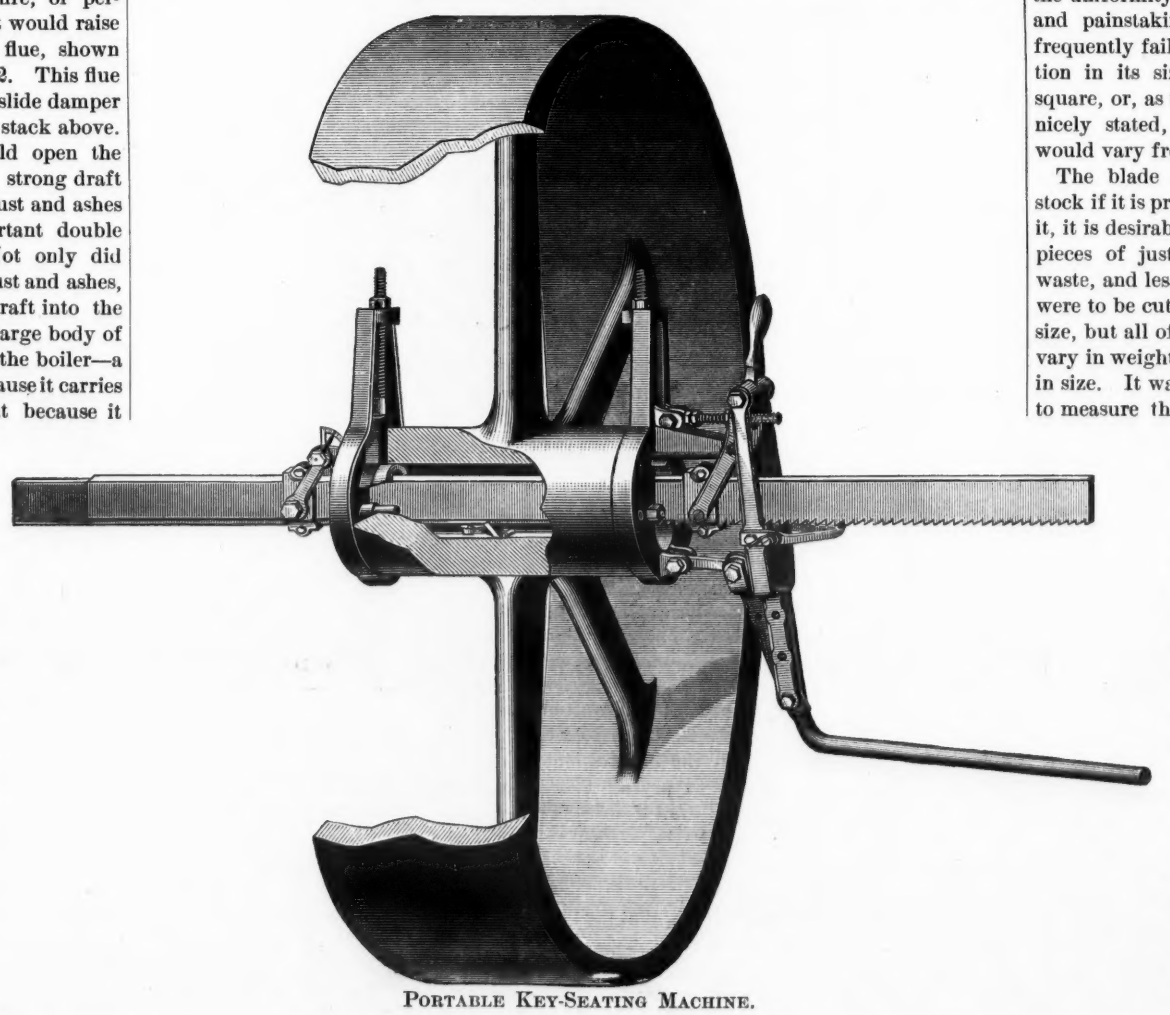
Interesting Appliances in One Boiler Room.

Portable Key-Seating Machine.

The object of this machine, which we illustrate herewith, is to cut keyways in all that large class of work which is usually done by hand chipping. The machine is portable, and is made to operate by hand, because it is easier to take the machine to the work than to handle the work; and it occupies no floor space.

The cut shows the machine attached to a pulley and in the process of taking a cut. It is operated by the bent lever shown at the right, which operates the two vertical levers on each side of the bar. To these levers is attached the pawl, which, by means of the ratchet teeth shown, forces the bar through. When the cutter is through, by depressing the hand lever which is seen above the bar the cutter will be lifted out of the cut, and the bar may be pushed back ready for another cut, thus saving the edge of the cutter and time in the back stroke of the bar. The feed is applied by the nut on the screw above the bar. The machine will cut a keyway straight or taper to any ordinary depth, without the necessity of measurements, as it is provided with an index for that purpose. The leverage may be increased or diminished by changing the position of the bolt which attaches the bent lever to the two vertical ones.

The size now made will cut a key-seat in a bore 5″ to 10″ diameter and 24″ long, though special sizes can be made if desired. The makers are The T. C. Dill Machine Co., 726 Girard ave., Philadelphia, Pa.



Portable Key-Seating Machine.

The daily newspaper reporter has been visiting the manual training schools, and concludes that "the importance of manual training in schools can scarcely be comprehended." We suppose he means that it can scarcely be comprehended by himself, and, judging from the fact that he speaks of the speed and engine lathes seen in the blacksmith shop and says of one of the students that "he was just taking his first lesson in the use of the cold hammer and chisel," we should think he was about right; the subject does seem to be a little beyond him.

Practical Details of Blacksmithing.

By B. F. Spalding.

BAYONETS—WEIGHING THE STOCK—ROLLING BLADES — ANNEALING — FORMING NECKS AND HEADS — SOCKET PADS — WELDING BLADES TO SOCKETS—WELDING SOCKETS—DROPPING.

In the early days of bayonet making, and until quite recently, the steel which was considered suitable for bayonet blades was tilted instead of being rolled. As gauge dies were not used, this operation had to depend for the uniformity of its products upon the skill and painstaking of the operator, and these frequently failing, led to considerable variation in its size. It was intended to be ⅝″ square, or, as the official specifications more nicely stated, 0.625″, but in large lots it would vary from $\frac{9}{16}$″ to $\frac{11}{16}$″.

The blade can be made of 14 ounces of stock if it is properly distributed, and to make it, it is desirable to have, to commence with, pieces of just that weight; more would be waste, and less not enough. If these pieces were to be cut off from bars not of uniform size, but all of the same length, they would vary in weight in proportion to the variation in size. It was therefore deemed advisable to measure them in such a manner as to give the right weight to each piece, irrespective of its size.

The plan adopted was the application of the method of measuring the bulk of irregular-shaped bodies by measuring the amount of water displaced by their immersion. Although this method was discovered some 2,100 years ago, it may never have been more usefully employed for common purposes than in the present case. A vertical hollow cylindrical vessel was provided. (See Fig. 1, page 2.)

This was of sufficient depth to receive the length of stock required. One made of sheet-tin or copper, 1½″ in diameter and 15″ deep, will answer the purpose. A flange soldered on the bottom provides a means of attaching it to a base of hard wood, on which it stands. Having filled this tube with water, a piece of steel of the required weight is immersed therein, causing an equal bulk of water to overflow. Withdrawing the steel, the water which remains settles down, no longer filling

the tube. A mark is made at the surface of the water inside of the tube, and a small hole is there perforated, the bottom of which is not lower than the level of the mark. Placing a finger over the hole to prevent the water from escaping, a bar of steel is gradually inserted in the tube until the water rises to the top, and then withdrawn. It is then nicked with a cold chisel at the water line, which shows plainly, and is then broken off and weighed. If it proves to be of correct weight, the hole in the tube is at the right place. If the piece is not quite heavy enough, the hole can be filed out some on the lower side, after which, replenishing the tube with water until all runs out of the hole that will, and then stopping the hole, another piece may be tried, and when the proper weight is thus obtained, the hole can be rounded by filing on the sides and top until it is about $\frac{3}{8}''$ in diameter. More elaborate apparatus may be constructed, but this is all that is essential.

The operation of cutting up the stock now proceeds, the helper replenishing the tube, the blacksmith gauging the bar and laying it on the face of the anvil, places his chisel on the mark, and the helper strikes a blow to nick it; he then turns it over, laying the nick over the hole in the anvil, and, placing his chisel on it, it is broken off by another blow from the helper. The piece does not fly, as it strikes a stop which is conveniently placed to prevent its doing so.

The piece is now ready to be necked, which operation is performed by drawing the end which has broken the truest in a pair of rounding dies, at the trip-hammer, to the shape shown in Fig. 2.

It is now ready to be rolled into the shape of the blade. For this purpose it is heated in a reverberatory furnace, and being held by a pair of gauge tongs which clasp it around the neck, is placed in the right position against set guides, where, when the working sections of the rolls strike it, they impress it with their form, which is to advance it a step in its progress by reducing the size and extending the length. There are nine grooves in the rolls. The first four prepare the stock by distributing it in the right proportions for the five which are successively brought into action to form the flutes on the three sides of the blades. The reduction of stock in the blank is quite rapid at a point *A*, Fig. 3, near the neck, as it requires to be somewhat in excess at the jointure to fill out the "jowls," or, as cutters say, "choules." Although these do not start out as abruptly as formerly, they appropriate the extra stock to increased thickness.

The rolls perform their duty with such celerity, that, after they are rolled, the blades still retain sufficient heat to render them soft enough for the finishing operations, by allowing them to cool gradually in a box of fine charcoal, into which they are immediately placed.

After the blade is annealed a heat is taken on the neck, and it is bent, either by hand in a tool fitted in a saw-block or at the drop. The power required is so slight that there is but little difference between the two methods in expeditiousness, and, as far as the quality of the work is concerned, one way is as good as the other. After bending, they have the shape represented in Fig. 4.

The round head on the end has been left larger than the neck, in order to form a shoulder for its support in a vise while it is hammered down to form a button-head, to adapt it to welding on the socket pad. The vise also receives the whole neck, the bend, and part of the blade, so that, in upsetting the button, the length of the neck remains unaltered. It is sometimes used under a small trip-hammer, and sometimes the heading is done by hand. The advantage, if any, which is gained by the use of the trip-hammer, is not sufficiently great to warrant the expense of procuring one for the purpose. Something might possibly be gained by its use if it was at liberty and would otherwise remain idle. The form of the button is represented in Figure 5.

It has been the general custom to make the bayonet solid, indeed, but built up of two parts, for the blacksmith has the benefit of this peculiar circumstance, which makes him more favored than other tradesmen: he can unite disjointed fragments into a solid whole. One of the parts of the bayonet, the blade, is now ready to be united with the other part, the socket, by welding. The socket is of iron, and is prepared from a piece of stock half an inch in thickness and $2\frac{3}{8}''$ square. This piece is heated and seized in the middle on one side by a pair of tongs, the jaws of which are half an inch wide, and admit the piece $\frac{3}{4}''$. Then, standing at the end of the trip-hammer, the blacksmith draws the stock on both sides and at the end of his tongs with a pair of straight dies which have rounded corners on the sides and front end. His tongs serve as a guard to protect the part of the stock which they grip from being struck by the dies, and thus this portion is left of the full thickness, and serves for the bridge of the socket. The pad is plated in such a manner that the fiber of the iron will run around instead of lengthways of the socket. The end opposite to the bridge is left somewhat thicker than the sides, to give enough material to work thoroughly when the button of the blade is welded on. (See Fig. 6.)

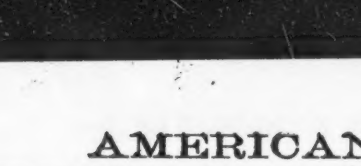


Fig. 5.

Fig. 2.

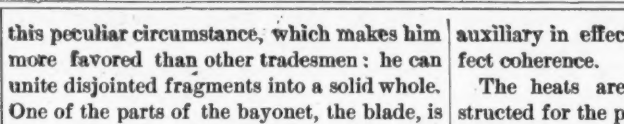


Fig. 4.

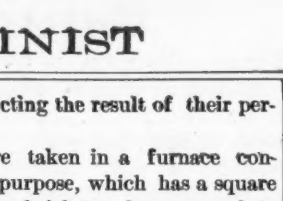


Fig. 6.

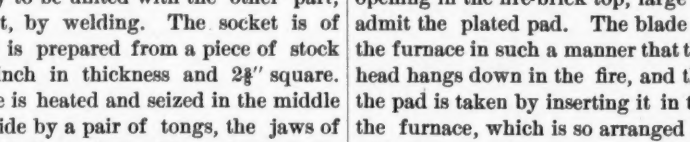


Fig. 3.

Fig. 3.

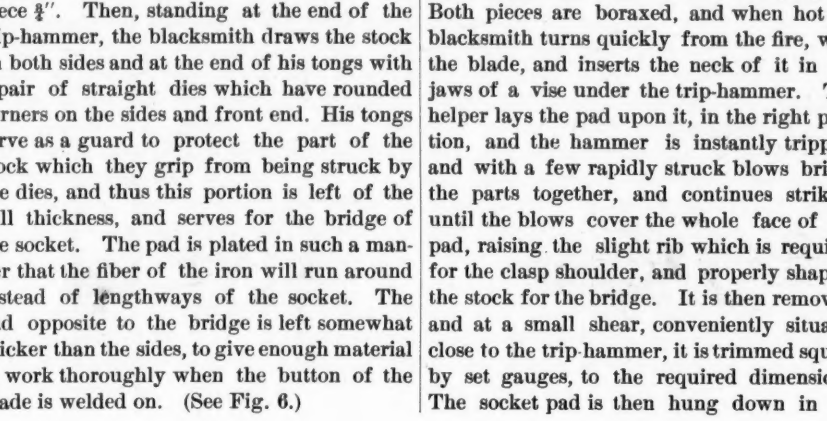


Fig. 1.

Fig. 7.

DETAILS OF BLACKSMITHING.—SEE PAGE 3.

The next operation is welding the socket pad to the blade. This weld is in a place where it is subject to severe tests. The surfaces welded will scarcely exceed $\frac{3}{8}''$ in area, and they have to resist the leverage of the length of the blade on one side and the length of the musket on the other, and when the bronzed veteran puts it to the crucial test on the field of battle, by allowing a fiery charger to lift himself upon it by the impetus of his own mad career, or in the bivouac borrows it from his comrade to pry up a frozen-down camp kettle, it will fail if it is not thoroughly united. That bayonets do stand tests as hard as these, and not part in the weld, shows that the welding of iron to steel can be made "solid," with all that the word implies. To make this solid weld, the conditions must be as they are on bayonets, the iron thick enough to bear the necessary working, and the steel in such shape as to touch first at a point, so that, as it sinks into the iron, everything on its surface will be driven off, and everything on the surface of the iron crowded off, and thus the two perfectly clean surfaces be brought into immediate contact, the measure of plasticity and viscosity due to the heat being a valuable auxiliary in effecting the result of their perfect coherence.

The heats are taken in a furnace constructed for the purpose, which has a square opening in the fire-brick top, large enough to admit the plated pad. The blade is laid on the furnace in such a manner that the button-head hangs down in the fire, and the heat on the pad is taken by inserting it in the end of the furnace, which is so arranged as to have a hot bed of coals there, for this purpose. Both pieces are boraxed, and when hot the blacksmith turns quickly from the fire, with the blade, and inserts the neck of it in the jaws of a vise under the trip-hammer. The helper lays the pad upon it, in the right position, and the hammer is instantly tripped, and with a few rapidly struck blows brings the parts together, and continues striking until the blows cover the whole face of the pad, raising the slight rib which is required for the clasp shoulder, and properly shaping the stock for the bridge. It is then removed, and at a small shear, conveniently situated close to the trip-hammer, it is trimmed square by set gauges, to the required dimensions. The socket pad is then hung down in the opening in the top of the furnace, and when it has acquired an even heat, it is laid on a concave "former," the end view of which, with the fuller used to give it a gutter shape, is shown in Fig. 7. When the pad has been bent as shown in the cut, the smith takes it out from the tool and hastily inspects it, to see that the weld has not failed; for the bending, with the stiff spot from which the neck protrudes to contend with, is very trying to the weld. This inspection tells whether to proceed, to repair, or to throw aside. If favorable, the socket is replaced in the tool, a round steel pin is laid in it, and the sides are brought down on it with a hand-hammer, one side abutting against one end, as shown by the dotted lines of the illustration.

The next operation is to take a welding heat on the socket, along the lap. There is a furnace provided for this especial purpose, which so encloses the anthracite coal which is used for fuel, that all the heat generated is forced through the small opening in the top, which barely admits the laying in of the socket. In this opening the socket is soon raised to a welding heat, and is then quickly clamped in the jaws of a vise, under the trip-hammer, with the neck down, and a pin being immediately inserted in the hole, the hammer is started, and the dies, being of the proper circle, the sides of the socket do not spread apart, but are held in position, and the lap is welded with a few blows. It is immediately taken to the dies of another hammer, close by, which are made to receive and form it the other way, with the neck at the side, and afterwards, being replaced in first dies, it is brought very nearly to the desired shape.

During all these operations, attention has been paid to keeping the distance correct between the blade and the socket; but, as in the operations of welding, which require that the pieces shall be got into the right places before they have lost much heat, it is necessary to have them go in free and easy, and they have not the exactness of shape and size that is desirable. They are, therefore, heated again in the sockets and necks, and struck between dies in the drop, which are intended to bring them to the exact shape required. This operation finishes them, as far as the forging is concerned; but, before they go to the finishing department, the sockets, necks and the parts of the blades as far as the jowls extend, are annealed. The rest of the blades having been previously subjected to this process, its performance in this case is all that is required to complete them, ready for cold machining.

Shop Notes.

Order and system seem to be among the predominating features in the shops of F. E. Reed, at Worcester—his system of keeping cost accounts, and filing drawings, and his plan of keeping a record of the performance of each tool in the hands of the inspector, being especially noteworthy. We were shown several blank forms which had recently been filled out by the inspector, giving the results of a test of a lot of lathes just completed. These blanks are numbered to correspond to the number of the lathe to which they refer, and can at any time be referred to in case it is desired to know just what the amount of variation from absolute accuracy was at the time of inspection. Mr. Reed says that the system is a great satisfaction to him, since it enables him to speak with entire confidence regarding any particular lathe in case of complaint, which, as every tool-builder knows, will occur once in a while, and would even if every machine could be and was absolutely perfect. Lathes are tested by attaching a stiff piece of iron to the spindle, and running a cut over it. The difference in diameter between the two ends of the piece is then measured by one of the new Brown & Sharpe micrometers for indicating the ten-thousandth part of an inch, and the lathe corrected, if necessary, until this variation is reduced to one or at most two ten-thousandths in six inches. The lathe is then tested in facing up a plate, to which a standard straight-edge is applied, and the variation in this way, if there be any, recorded upon the blank. There can be little doubt of the superiority of this method of measuring variations, and recording their amounts, over the plan of simply asserting that a tool is absolutely perfect; for, while many tools are built which are near enough to absolute perfection to be accepted as practically perfect, it is safe to say that no tool has ever been built which was absolutely perfect; and what one mechanic would consider absolute perfection, another, with a different conception of accuracy, or engaged upon a different class of work, might consider very far from perfect. But they could agree upon what one ten-thousandth of an inch means, and whether a certain variation from absolute accuracy, expressed in such terms, would answer their purpose or not. It also affords a means of knowing whether or not the builder's and the purchaser's conceptions of absolute accuracy agree, which is a point worth consideration.

We noticed in the shop a method of rigging up a drill press to drill small and medium sized holes in rather heavy castings, such as lathe beds. The holes drilled are of such a size that a large drill press would be

inconvenient, and consequently an ordinary sized press was taken, and two rails laid along the floor under the spindle, and extending from side to side the required distance. These were planed up and made true. Upon these were placed two small carriages or trucks made of iron, and having turned wheels, upon which the lathe bed or other casting to be drilled is placed. By this means it can be moved from side to side with the greatest facility, and the advantage secured of using a press adapted to the size of the holes to be drilled without regard to the weight of the castings operated upon.

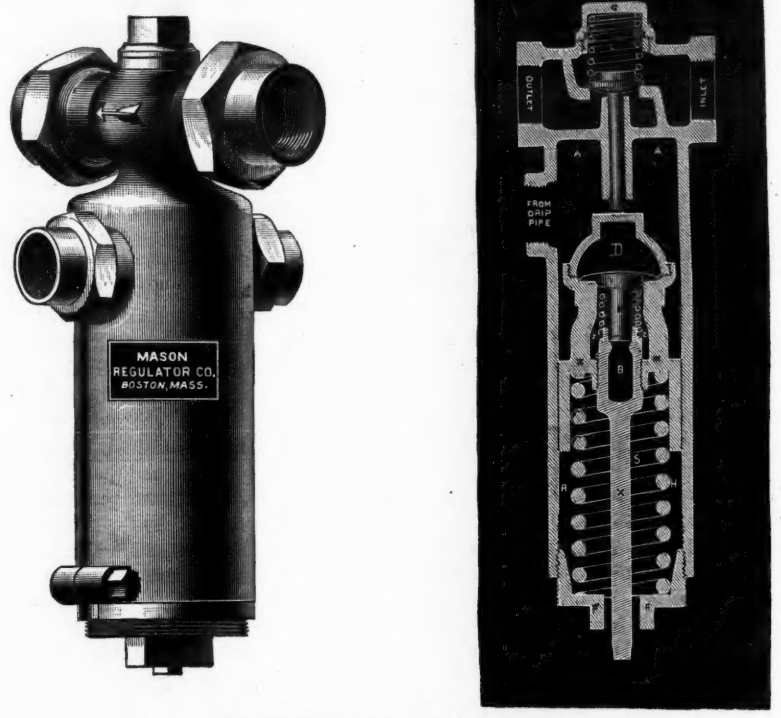
Very large numbers of small parts of lathes, and some other tools, are made and placed upon shelves and racks in the stock-room, ready for assembling, the system of manufacture by milling machines, jigs, and other special appliances, securing entire interchangeability of parts. Racks or frames are erected in this room all over the floor, and as high as a man's head, which support shelves open and accessible from all sides. Each of these is devoted to the parts of some certain size of lathe, milling machine or other tool, and all finished parts are placed in it as soon as completed, a record being kept by the man in charge, who also keeps a record of their cost, and charges it to the machines as the parts are called for by the erecters. The room looks very much like a show-room arranged for the display of finished work. It is a pleasure to go through it, and must produce a very favorable impression upon prospective customers. Though Mr Reed, when asked a question regarding the matter of a large contract for lathes, recently given out by the Westinghouse Air Brake Co., would not make a positive statement regarding it, a man who is in a position to know something regarding the matter, said positively that Mr. Reed had secured an order for 207 lathes, which is believed to be the largest order for lathes ever given in this country.

Across the street from this shop is the shop of the Whitcomb Mfg. Co.—Mr. Whitcomb being a veteran in the machine tool business, having been in it longer than any one else in Worcester. The shops are now devoted exclusively to building planers, though in years past Mr. Whitcomb has built a general line of tools. A very interesting conversation was had with him regarding the development and growth of machine tool building.

Though the shop is now equipped almost entirely with the latest improved tools, one or two examples of machine tool building in ante-bellum times are to be seen, looking very odd beside the latest design of Whitcomb planer. Mr. Whitcomb thinks that our civil war had more than anything else to do with the bringing about of the simpler styles of machine design which prevail in these days. The Government would have nothing put upon a small arm or gun for mere ornamental purposes, and everything furnished by contractors during the war, from a bayonet to a gunboat, had to be as plain as possible, every part and every stroke of work done upon them being for a definite utilitarian purpose. After a time it gradually became recognized that true beauty in machine design consisted in plainness and strict adaptation to a useful purpose, and this led to the entire abandonment of mere ornamentation, and the leaving off of all those "ogees and filigrees" which in their day were considered so necessary to a good looking machine, and which in these days appear so odd, and are considered so much of a nuisance. In the early days of machine designing, architects were the only draftsmen available, and of course it was natural for them, in making drawings of machinery, to introduce those features which were used in making buildings appear pleasing to the eye, thinking that the same ornamentation made machinery look well. An old planer standing in Mr. Whitcomb's shop bears the marks of the architectural draftsman all over it, and, upon speaking of it to Mr. W., he said that the drawings were made years before the war, by a man who had been originally trained as an architect.

The Mason Combination Reducing Valve and Steam Trap.

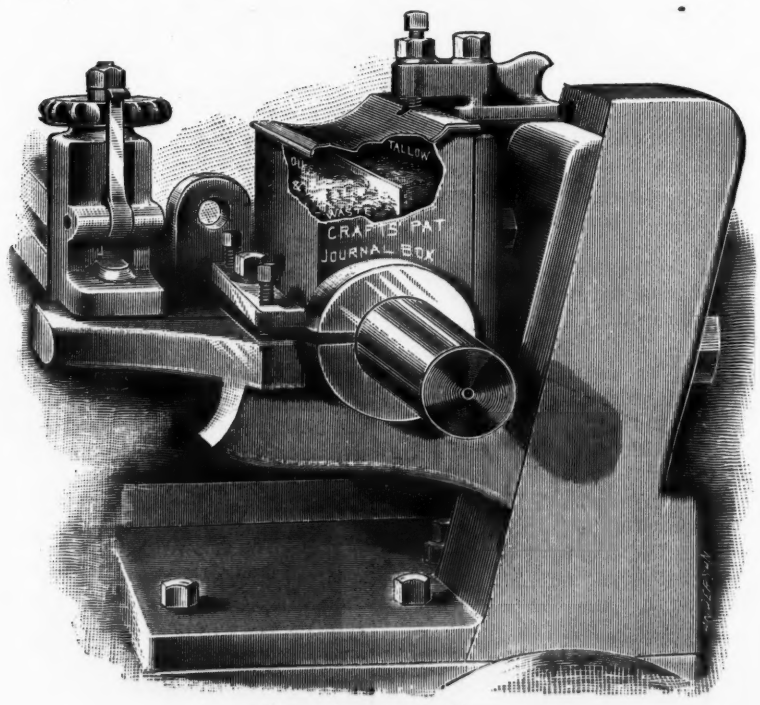
This valve was originally designed for use on steam car-heating systems, where the locomotive pressure is reduced by a valve to about 40 lbs. in the service pipe, and is then regulated separately for each car. The advantages of having the reducing valve and trap in one shell are obvious. This device occupies only a little more than the space needed for a globe valve, is very easily applied, and will not freeze. It has also been found to be applicable for larger systems, as for steam heating in buildings, and for manufacturing purposes, where it can be placed in the steam pipe from the boiler, and the return pipe can be connected with it instead of into an ordinary steam trap. For reducing and trapping the steam for small systems, as in an office, it is very convenient.



Reducing Valve and Steam Trap.

By referring to the sectional view, the operation will be understood. The steam pipe from the supply enters the passage marked "inlet," and passing through the main valve, which is normally open, fills the system, and thence through the return or drip pipe the condensation comes back into the trap portion of the device, marked *A A*. When the pressure in the system rises above the desired amount to which the valve has been previously set by compression of the spring *S S*, the piston *Z Z* is forced down, thereby allowing the main valve to close, assisted by the high pressure steam and the spring *L*. Steam is thus shut off from the system. This operation is repeated as often as the pressure in the system rises above the required point. The trap portion of the device operates on the well-known principle of expansion. The chamber *D*, which forms a part of the piston *Z Z*, and is carried with it in its movement, is filled with an expansible chemical. The valve *K* is open when the trap is cold, so that condensation can pass out freely. When the trap is free from water the steam expands the liquid in chamber *D* and shuts the valve *K* by the metal diaphragm. When condensation again accumulates, the heat diminishes, the chamber *D* contracts and the valve *K* is again opened.

The trap can be adjusted to discharge at any temperature by turning the rod *X*, which is fitted for a wrench. The reducing valve is adjusted to the desired pressure by turning the plug *F F*. The drip from the system can be attached to either side of the valve, as shown in exterior view. It is manufactured by The Mason Regulator Co., Boston, Mass.



Crafts' Journal Box.

Crafts' Journal Box.

In describing the wood-working machinery built by E. and B. Holmes, of Buffalo, N. Y., we have frequently mentioned Crafts' journal box, which is used on all machinery built by this firm where its application is practicable or desirable. We now present an engraving showing the construction of this box. As will be seen, the cap is a very heavy casting, comparatively, one object of this being to make it serve as an anvil to absorb the force of the blows given by the knives. An unusually heavy body of babbitt is used, and it is dovetailed into the box in both directions, no cast-iron chipping strips being used, which project into the babbitt and are liable to come in contact with the journal when the babbitt becomes worn. The upper part of the box is divided into two compartments, in one of which are oil and waste, in the other tallow or other grease. The object of this is to provide a double system of lubrication, so that, if the oil should become exhausted, the tallow would be melted by the rising temperature of the box and serious damage or overheating prevented. Ordinary cap screws are not used, but instead a broad vertical planed surface is provided at one side of the cap, to which it is firmly secured by steel bolts. Above this surface is a steel dog provided with a set-screw and jam nut, the screw bearing upon the cap in the middle of its length, thus securing an even bearing throughout the box. This construction not only makes the adjustment of the box very easy, but does away with the necessity of wood or other hard substances between the cap and the box, candle wicking being used instead, which prevents the oil from escaping, and permits ready adjustment without the necessity for removing or reducing the thickness of packing. The box in use has given the best of satisfaction, not one of them having given trouble by heating, so far as known to the manufacturers. A machine fitted with them has been running in the city of Buffalo for six months past, at 5,100 turns per minute, working kiln-dried maple, without heating, and without the necessity for adjusting boxes during that time—a performance which will be conceded to be very creditable.

The Cost of Steel in Great Britain and America.

We see from a report just published on the production of steel in Great Britain and the United States, 1,048 hands in the latter country produced 4,500 tons of Bessemer rails in a week, which would average 4.3 tons per man. In Great Britain, on the other hand, 600 workmen produced 1,500 tons in the same time, or only 2½ tons per man. The average wages in America were, however, fully 35 per cent. higher than in Great Britain, which nearly equalized the cost of labor per ton in both cases. The difference in the actual cost of production in the two countries must then principally be attributed to the great distances from which the American works have to obtain their supplies of raw material for the manufacture of Bessemer steel, and this obstacle to the development of the rail industry in the United States would be obviated if the basic process were introduced into that country, since in many instances suitable mineral could then be found in close proximity to coal fields. There is, however, no probability of the manufacture of Thomas steel being developed in America at present, since a group of the Bessemer works has bought up all the patents referring to the product, and can consequently prevent all new works from producing it.—*The Practical Engineer* (London).

The latest application of the velocipede principle has been made by a sportsman, who made a sled to run upon the ice, which he propelled by means of foot pedals, the same as a bicycle. The wheel which is rotated by the pedals is fitted with steel spurs, which take hold of the ice, and it may be revolved at various ratios of speed to that of the pedals. The resistance of friction is so slight that it is said very high rates of speed are attained by it. When the wind is favorable the propelling wheel is lifted off the ice and a canoe mast and sails used instead.

The next meeting of the American Society of Mechanical Engineers will be at Erie, Pa., beginning May 14 and continuing three days.

Death of a Well-Known Locomotive Engineer.

Robert M. Clark, an old-time locomotive engineer, died recently at Bennington, Vt., at the age of 73. For more than forty years Mr. Clark—latterly Uncle Johnny, in deference to his English origin—has been a familiar figure along the line of the Troy & Boston Railroad, and amongst two generations of railroad men. With just enough eccentricity about him to give spice to companionship, "Uncle Johnny" will be missed by a host of friends, not only amongst railroad men, but amongst citizens from one end of the road to the other. One of the most careful of engineers, if ever men deserve success for faithfulness and strict attention to duty, Robert M. Clark deserved his success.

A Statement by "Iron."

The following communication will explain itself:

Editor American Machinist:

We are in receipt of a letter, dated March 16th, from the editor of *Iron*, published at 161 Fleet street, London, E. C., referring to your article in regard to the reproduction of our tools by an English firm, and stating that "No application of any kind whatever from any person has ever been made to this journal respecting your protest. Had it been made, the matter would have come before me, and I should unhesitatingly have published the communication, subject, of course, to my editorial supervision. . . . . As an Englishman, and as the editor of *Iron*, I can have no sympathy with the alleged malpractices. . . . . I must further ask you to give this repudiation the same publicity as that accorded to your statement that your London agents had tried in all quarters to get your letter, or some modification of it, inserted in the English mechanical papers, but without success."

Please oblige us by giving the statements of the editor of *Iron* publicity.

You will note that our original letter was reprinted and commented upon in the *Mechanical Progress*, published at 23 and 24 Whitecross street, London, E. C., February 28th.

Yours truly,
Brown & Sharpe Mfg. Co.
Per L. Chafee, Jr.

LETTERS FROM PRACTICAL MEN.

Acknowledgment to Mr. Beale.

Editor American Machinist:

It is certainly with much satisfaction that I acknowledge my indebtedness to Mr. Beale for setting me right about Mr. Corliss and his engine frame, and for the many items of historical interest he has so pleasantly combined in his communication. After acknowledging that I was entirely wrong, and accepting the fact that Mr. Corliss knew "a powerful sight" more about the Corliss engine than I did (a fact every one else knew before), it would at first seem that there is nothing more for me to say. But I cannot do otherwise than beg pardon from every Corliss engine builder who has put the same interpretation on my remarks as done by Mr. Beale, nor can I consistently allow one point in Mr. Beale's criticism to pass unanswered, and that is when he takes me to task for my use of the word girder. I have always called that sort of an engine bed a girder bed, because I supposed that was its name; and where I referred to it as a girder, it was simply because the strains I was considering were such as come upon a girder. There may be various strains—thousands, possibly—in an engine frame that I never thought of. But as relates to the one in question I think it is of the class girders are subjected to, and independent of the others.

The fact is, I was attempting to uphold a principle (which may be wrong), and selected as an illustration the use of a central support under the center of a Corliss engine bed (which may have been an unhappy one), but I still think the principle correct, and am glad to learn that this idea has the tacit endorsement of the best engineer this country ever knew, Mr. George H. Corliss himself. For, according to Mr. Beale's report of the hundreds of engines he is known to have built, only a few have been found with a central support, and in those cases the special reason not given—and among his latest and largest work, he absolutely *made the support adjustable.*

Was it because he was afraid the stonework would go down at that point where there was no load, or because it would come up, and so provided a means for avoiding what was liable to occur—a bending of the frame? I do not believe I was mistaken as to the fact, though I was, unquestionably, as to Mr. Corliss's way of surmounting the difficulty.

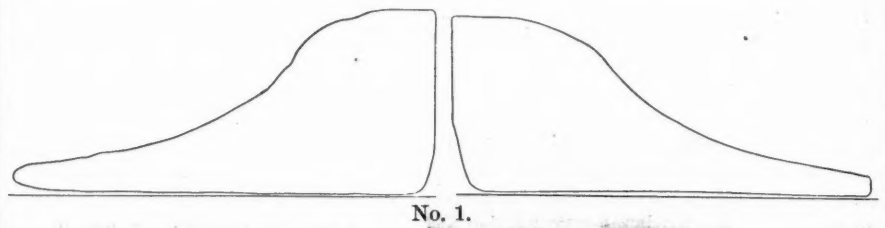
It must have been evident to every one who worried through my address that I endeavored to condense a lot of thought in a small space, and that it was not possible to consider many external questions, but I had no idea that it was possible to concentrate so many blunders in a single paragraph as to require two of us and considerable space in the American Machinist to straighten them out.

John E. Sweet.

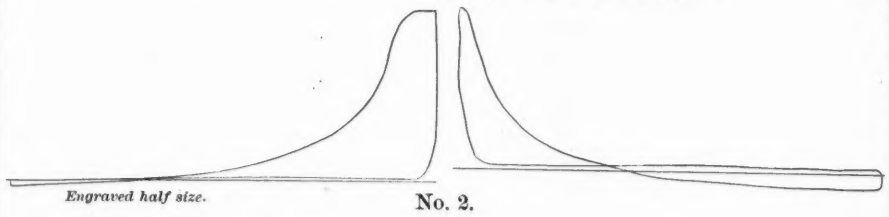
Using the Indicator.

Editor American Machinist:

The enclosed cards will, I think, be of interest to some of your readers, as showing the necessity of using the indicator for adjusting the valves of automatic engines. Cards No. 1 are a pair of simultaneous diagrams, showing the average daily work of the engine; they are not specially selected, but are a fair sample of cards taken daily to ascertain the amount of work done by the engine. Cards No. 2 are from the same engine, are also a simultaneous pair, and were taken to ascertain the amount of power required to drive the shafting of the mill. They were taken only ten minutes later than No. 1, and without any alterations to the engine.



No. 1.



Engraved half size.

No. 2.

Cards No. 1 will be seen to be very nearly alike in all essential respects, the work being fairly divided between the ends of the cylinder.

Cards No. 2 will be seen to vary greatly in the length of the cut off, fully 25 per cent. more work being done in the crank end of cylinder. This is due to the angularity of the connecting rod, and should the cut-off be equalized at this point it would vary just as much at a later cut-off.

The point I wish to make clear is the necessity of using the indicator to equalize the cut-off from the average load. This, of course, is well known to the old hands at the business, but those I wish to reach are the young men just beginning, and who, like the writer, have had limited means of acquiring the necessary knowledge.

When I commenced to use the indicator I was situated in a small village, far removed from any chance of obtaining personal instructions, and I am pleased to say that the larger share of my knowledge of the indicator has been learned through this paper, and through the courtesy of its editor.

The practice of blocking up the governor and adjusting the cut-off at some given point, say ¼ stroke, as is the common practice, is very far from correct, as any user of the indicator will readily admit.

I could show some rather peculiar cards taken from engines as the erecters left them, not from any lack of knowledge or skill on their part, but simply from the fact of their not using the indicator.

Eufaula, Ala. Richard Thirsk.

Wants the Opinion of Our Readers.

Editor American Machinist:

I would like to ask your readers a question: Given a tubular boiler 52″ diameter, with 63 three-inch tubes 9 feet 10 inches long, shell $\frac{9}{32}$″ thick, heads $\frac{5}{8}$″ thick—been in use about one third of the time for sixteen years—shell and heads in fair condition, material C. H. No. 1; six years ago found the heads bulged where the stays were fastened to same, and an inspection revealed that the stays, seven in number, were made of $\frac{1}{2}$″x1$\frac{3}{4}$″ inch iron, with only one rivet at each end; these stays had straightened and let front head bulge outward $\frac{5}{8}$″, and the rear head $\frac{5}{16}$″; owner had a boiler maker put in five new stays on each end, two of the old stays being left in, and now I find that three on each end are all right, while the other two are faulty in design, and some defects in workmanship.

I had the boiler filled with warm water at about 110° Fahrenheit, and then used a pump to give 95 pounds' pressure to the inch, when I found the back head had sprung out $\frac{5}{32}$″ at the one point measured, while the front head, at three different places between the stays, sprung out $\frac{1}{16}$″, $\frac{9}{32}$″ and $\frac{1}{8}$″, and when pressure went down they returned to former place. I am satisfied that this springing has been going on ever since the boiler has been in use, and it is quite evident to my mind that the iron of these heads has become more or less crystalline, and with such use as they have had, namely, 100 pounds' pressure of steam, it would only be a question of time when they would go out too sudden for the comfort of fireman.

What I want to know, is, can these heads be annealed and straightened back so as to leave the iron in its original condition?

Westfield, Pa. Albert Baker.

Preventing Clinkers—Rattling Valves—Why Globe Valves Leak.

Editor American Machinist:

In No. 12, A. K. B. asks about preventing clinker. They can be prevented by steam. When it is wished to prevent clinkers forming, put a ¾″ steam pipe, on one side of which put in not larger than $\frac{1}{16}$″ holes, some four or five inches apart, this pipe to be set close to the under side of grate. Keeping small jets of steam issuing from these holes all the time will prevent clinker. Experience will tell how much steam to use in each particular case.

The use of such pipes under the entire grate surface will prevent them forming anywhere. Whether any one can afford this means of prevention must be determined by the parties in interest.

It is claimed that the heat resulting from the combustion of the decomposed steam will more than compensate for the heat required to dissociate it. If so, such a method of preventing clinker would be economy. The writer has not had sufficient faith in the economy to give it a trial. One thing that causes clinker to form and adhere to furnace walls is the unconscious habit some of us get into, of throwing the coal into the furnace in such a way that it flows along over the fire, and the walls serve as a check, so that the fire is thicker at the walls than anywhere else, transforming the fire at that point into a fire suiting a blacksmith's work with the intense internal heat. This heat melts the waste matter of the coal, forming a solid mass, and, being near the brick, and that being also highly heated, they amalgamate, and it is hard to separate them. The best time to do this is just after the fire is hauled and the furnace is commencing to cool, as at that time contraction is going on. Some firemen throw oyster shells around the edges of the fire, which will crack off the clinker.

A thick spot in the middle of a fire will burn out the grates at that place, for the reason stated above. The gas coals are worst for forming clinker, and will always give a great deal of trouble.

A. B. C. wants to know what makes his exhaust valves rattle. When he says that the engine is under-loaded he tells the whole story. The cause is the expansion of the steam—on the steam side of the piston—below the pressure of the atmosphere, and the consequent throwing of the valve from the seat. Attaching a condenser would stop the rattling of the valves, but might make the engine pound, unless he could give enough compression to prevent it. Sufficiently stiff springs could be put into the valves to hold them on their seat; but this would be hard on the valve stems, and they would wear out in a short time. The other remedy is to carry a sufficiently low steam pressure, so that the valves will be held on their seats all the time. This will take more fuel.

Mr. P. H. Bullock gives some good reasons why globe valves leak. I would like to add another reason, which is the thoughtless habit some pipers have of never holding a valve with a wrench when screwing in a piece of pipe, or when screwing a valve onto a pipe they are more apt to put the wrench on the wrong end of the valve, or the end farthest from the pipe. This brings all the strain on the soft brass shell of the valve, and sixty per cent. of the valve seats will be twisted out of shape.

W. E. Crane.

How to Harden Thin Pieces.

Editor American Machinist:

If correspondent who wishes to harden steel plates $\frac{1}{16}$″ thick will adopt the following system, he will meet with perfect success. Provide two pieces of iron about 6″x 6″x1″, with one surface on each block planed, spread a liberal supply of good sperm oil on each planed surface, place the blocks near by in level position to insure an even thickness of oil, and keep the blocks cool. Immerse the steel plates in molten lead as far as they are required to be hardened; when a red heat is obtained, drop the piece quickly upon the oiled surface of one of the iron blocks, and simultaneously lay the other iron block upon the work; when cool they will be found true. I have used this system for years for hardening thin steel tools with universal success.

Buffalo, N. Y. J. Lester Osgood.

Tempering Thin Plates—Solder for Aluminum.

Editor American Machinist:

Sheet-steel of the dimensions stated by your correspondent in the American Machinist, March 21, can be successfully hardened between two cast-iron blocks placed in a screw press, or any kind of hand press; holes should be drilled in the corners of the lower block for spiral springs of sufficient power to keep the blocks apart.

The steel should be heated (a small gas furnace is preferable), and quickly inserted between the blocks, and pressed hard until cool enough to insure against drawing temper.

A good plan is to have two pieces in the furnace at once, and allow one to cool when the other is heating.

To draw the temper, brighten part of the piece on an emery wheel, and then run them together with sand in a sheet-iron tumbler under which is a fire (a few gas jets are the best), until the desired color is obtained.

Solder for aluminum to be used for the blow pipe, 10 parts silver, 10 parts copper, 20 parts aluminum, 60 parts tin, 30 parts zinc.

For solder with the common soldering iron, use 95 parts tin and 5 parts bismuth, or 97 parts tin and 3 parts bismuth. The flux to be used in all cases is either paraffine, stearine, vaseline or benzine. The articles must be well cleaned before soldering, and heated just enough to make the solder adhere.

R. T. Torkelson.

About Fire-Cracking Steel.

Editor American Machinist:

Some time since, in starting work in a new machine shop, I had occasion to have made four milling cutters, about 2½ inches diameter and ⅝-inch thick. They were all made from a 2½-inch bar, not more than three inches of its length being used for the four cutters. As the heating forge was not ready for use, and the cutters were wanted in a hurry, I sent two of them to a friend, the foreman in another shop, who was a "steel sharp," and who especially prided himself on his ability in hardening and tempering milling cutters, requesting him to harden them himself, and to use particular care with them. The grade of steel was one of the best American grades, and one which my friend was in the habit of using. He returned them hardened and both badly fire-cracked, with a letter stating that he had used extra care, and advising me not to use any more of that steel for milling cutters. By this time the other two cutters had been made, and I sent them, together with the fire-cracked ones, to the New York agent of the steel manufacturer, stating the facts, and asking him to have the two new cutters hardened and tempered. He returned them hardened and tempered without a sign of a crack, and they have since been used to do a very large amount of work without failure, and the same brand of steel has since been used in our shop with entire satisfaction. Moral: Don't condemn a noted brand of American steel, or all American steel in general, because one man manages to fire-crack the tools made from it; but try another man who can harden it without fire-cracking. I believe Mr. Goodyear is right in stating "that there is not a steel imported which cannot be fully equaled by American steel through all the broad ranges of use to which steel is put." W.

Should the Draftsman Make the Pattern Maker's Drawing?

Editor American Machinist:

I don't know what the pattern makers think of Mr. Crank's ideas on drawing-room economy, in your issue of March 21, but I believe I could guess. It seems to me quite the opposite to economy, especially with regard to the drawing-room, to advocate separate drawings for pattern shop, machine shop and blacksmith shop; but I will confine my remarks to that part of Mr. Crank's letter where he refers to drawings for pattern makers. He says: "Give a pattern maker a detail drawing of an engine cylinder, drawn to a scale of ½ or ¼ size, and the first thing he will do will be to plane off a board and make a rude drawing, full size of cylinder, and then he is ready to commence work." Mr. Crank is right. It is just what I would do, and if any gentleman from the drawing-room wanted to do it for me, with the idea he could do it "much better," as Mr. Crank says, then there would be a little rippling of the waters.

I don't see this point quite so clearly as to draw the same corollary as Mr. Crank does. If the lines of a full size cylinder drawing that the pattern is to be made from, and "which could much better be done in the drawing-room," cannot be used to build the pattern by, then it is of no more use to the pattern maker than the drawing that is drawn to ½ or ¼ size. Let us see if this is so. After the pattern maker is given this full size cylinder drawing, the card of instructions informs him that in all cases he must work to the figures. If the lines of the drawing are right—and they must be to be of any use to the pattern maker to build his pattern by I would like to ask what is the use of the figures? Again, the instructions are that the pattern maker must allow for finish, and also his own "shrinkage and draft." If the full size drawing is to be made in the drawing-room for the pattern maker to make his pattern from, and because it is done much better, then the stock and shrinkage (to say nothing of the draft) must also be considered in the drawing-room, or the drawing will be of no more use, as in the case of figuring, than any other drawing.

In the matter of shrinkage it is not a question of adding so much to the length, width and depth. There may be measurements that are more important than these, so that it becomes a necessity that the drawing for the pattern maker should have the shrinkage allowed on it.

If the instructions that Mr. Crank gives are to be kept, my opinion is that it is better to allow the pattern maker to lay out his own drawing, if the foreman pattern maker does not.

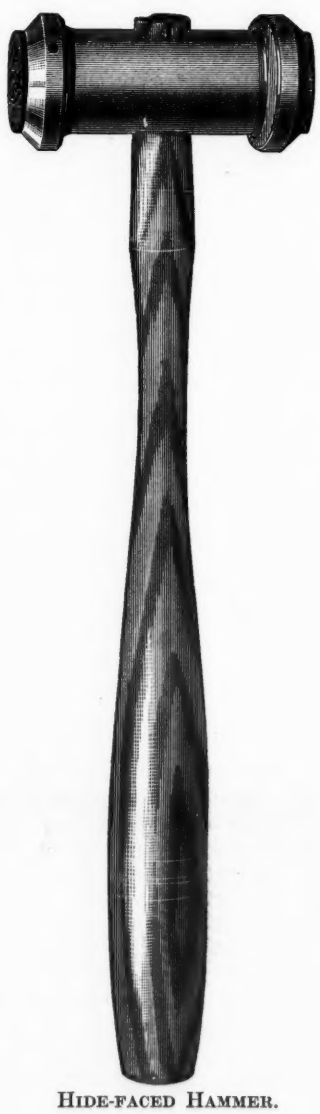
In the American Machinist, Nov. 10, 1888, Mr. Crank says, "In some places it is the practice to make drawings for the pattern maker, in which the draftsman has made allowance for shrinkage." This is better than making a drawing for the pattern maker without shrinkage; and yet, in the matter of shrinkage, I think the pattern maker ought to be the better judge, because the shrinkage varies so much there can be no rigid rules made. P. S. Dingey.

Another View of Piece-Work.

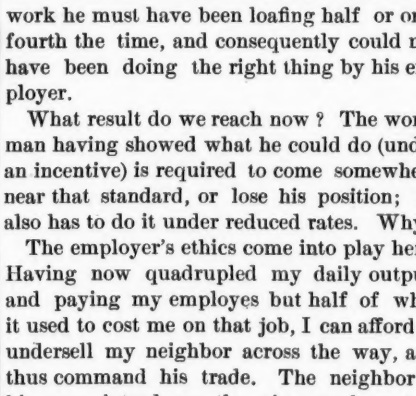
Editor American Machinist:

In the interesting testimony on the piece-work question, a point or two occur to me that have not been taken into consideration. They are not ethical.

In the first place, I do not believe in talking ethics to a day laborer who is doing skilled work and receiving the pay of an unskilled workman. He perhaps is laboring under the impression that his employer is trying to get the better of him by grinding more out of him than he is getting paid for, and this to him may be ethics, but it does not feed the family at home, so he does as little as he can, perhaps, goes home discontented, and waits, Micawber-like, for something to turn up. Something does turn up. They are going to introduce the piece-work system in his shop. What is that? A system by which a man is paid so much for a job, and, as a result, the more jobs he does in a day the more his pay at the end of the day. He is not to be paid more per job, so his employer does not receive less profit on that job, but he does receive as much more profit in the day as the workman does more jobs; two, three, or four profits, perhaps. But the workman is not inclined to be logical just now. He pitches in. It is just the chance he has been hoping for. He does, one writer claims, four times the work per day. He works till the "perspiration rolls from his forehead, even though there is no heat in the shop, and it is the middle of winter." Result: We must cut this man's wages down; he is making more money than we are. True, our profits have been multiplied by his hard work; still, now is the time to talk ethics to him. Let us tell him when he worked day-work he must have been loafing half or one-fourth the time, and consequently could not have been doing the right thing by his employer.



Hide-faced Hammer.



A New Emery Wheel.

What result do we reach now? The workman having showed what he could do (under an incentive) is required to come somewhere near that standard, or lose his position; he also has to do it under reduced rates. Why?

The employer's ethics come into play here. Having now quadrupled my daily output, and paying my employes but half of what it used to cost me on that job, I can afford to undersell my neighbor across the way, and thus command his trade. The neighbor in his turn introduces the piece-work system with the same righteous desires.

Who is there, however, but believes that, give a man a chance to increase his daily profit, he will do so? The abuses that have crept into the piece-work system are the result of an incentive, where formerly there was none, and then cutting off the incentive because its results showed too glaring against the former background. As yet, we have not heard from the employer whose men did less work under piece-work than under day wages; that is, before cutting off their incentive. Albert A. Longaker.

One Way of Moulding a Gear.

Editor American Machinist:

Following is a description of one way of moulding a spur gear so as to reduce the face equally on both sides any given amount, thus keeping the arms in the center.

The particular gear in question was 48″ diameter, 6″ face, and 2″ pitch, with arms tight in the center, and from this a casting with a 4″ face was wanted, with arms central.

A flask of the proper size was secured, and to this was fitted a chuck 4″ deep; after placing the pattern on a plain follow-board, the chuck was laid on and blocked up 1″ from the face of the board, and the teeth or outside rammed up level with the top of the chuck, and after nailing each tooth thoroughly, the parting was made 1″ below the top of teeth, the hub put in place, and the drag rammed up, bottom-board put on, and the flask rolled over. This leaves the pattern 1″ above the top of the chuck; the parting around the outside of pattern was made flush with the top of chuck, and arms parted as usual. The top hub was put on, and cope rammed up. Of course a clean lift is not looked for, as it could hardly be expected to cope out an inch of the teeth of a spur gear, and that, too, against a back-draft. Care must be taken, however, to put a row of gaugers close to the teeth, to prevent the sand tearing away as much as possible. After the cope is lifted off, the rim of the gear on cope side is filled up flush with the joint, the loose sand around the pattern removed, the gear drawn and the chuck carefully lifted off and laid aside, and that portion of the rim in the drag filled up, the chuck replaced, the mould finished as usual, the cope put on, and if the job has been neatly done there will hardly be a fin on the casting when taken from the sand.

Where it is necessary, it is a very easy matter to cast a shrouding on either or both sides by having a short piece or segment of the shroud made, and bedding it in carefully where the rim has been stopped off.

W. A. Jones.

A New Emery Wheel.

We illustrate herewith an emery wheel, which involves a new principle of construction. The wheel is made up of two or more series of sections, the sections of each series being similar in composition to each other; that is, they are composed of the same size grains of emery or are of the same degree of hardness. The sections of each series are arranged alternately with sections of another series which are either harder or softer in composition, or of different size emery, or, if desired, of different material, such as corundum. It is designed in this construction to form a wheel that will last longer and cut faster than a wheel of ordinary construction. It is claimed that the hard sections prevent the work from being pressed too heavily upon the soft sections and from tearing the soft sections apart before their cutting qualities have been used up, while at the same time the soft sections cut as fast as if the wheel was composed entirely of such material. The wheel is moulded by means of a form having compartments corresponding to the sections desired; the material desired for each series of sections is then placed in the respective compartments, the form is lifted out, and the plastic mass is then pressed or tamped in an iron mould. It is claimed that the wheel is stronger and less liable to burst than a wheel of common construction; a wheel 16″ x 2″ having been tested at a speed of thirty-five hundred revolutions per minute.

It is further claimed that such a wheel is less liable to glaze than an ordinary wheel, for the reason that the particles of coarse emery that have become detached from the wheel are rubbed over the surface of the harder sections, so as to roughen that surface and thereby prevent glazing, while the fine sections following the coarse ones remove many of the scratches made by those coarse sections.

This wheel was invented and is made by Robert W. Hardie, Albany, N. Y.

Improved Hide-faced Hammer.

With this we present an illustration of a small hide-faced hammer, intended for jewelers' use, and for other light work, its weight being 10 oz.

It is made of malleable iron, neatly finished all over. The rings at the ends screw onto the body of the hammer, and have an inside beveled surface which holds the faces firmly in place. The faces are very easily renewed by simply unscrewing the rings. It is a very neat hammer, balances nicely in the hand, and is an excellent substitute for the mallet in all cases where an elastic blow is to be given, without danger of injury to the work. The maker is W. W. Oliver, Buffalo, N. Y.

Zinc, of all ordinary metals, expands or contracts the most by the application or withdrawal of heat.

AMERICAN MACHINIST

To prevent delays all Communications should be addressed to the Company.

PUBLISHED WEEKLY
BY
American Machinist Publishing Co.
96 Fulton Street, New York.

Horace B. Miller, Pres't and Bus. Manager.
Lycurgus B. Moore, Treas. and Sec'y.

F. F. Hemenway, Editor and Mech. Engineer.
J. G. A. Meyer, Fred J. Miller, } Associates.

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$2.50 a year in advance, postage prepaid in the United States, Canada and Mexico.
$3.50 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 Bouverie Street, Fleet Street, London, Eng., will receive subscriptions for the American Machinist, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Central News Company, Philadelphia, Pa.
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The Williamsburgh News Co., Brooklyn, E. D., N. Y.

NEW YORK, APRIL 4, 1889.

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A Boiler Manufacturers' Convention.

A call has been issued from Pittsburgh for a convention of the boiler manufacturers of some half dozen States, the object being the formation of an association of such manufacturers. The call sets forth the objects to be accomplished, as the creating of a greater interest in boiler making, to bring about the use of better material, and to establish a minimum price.

The first two objects named are entirely praiseworthy, and, considering the fact that there have lately been an alarming number of disastrous boiler explosions, we have no doubt that the public will encourage an association that will see that better material is used, and better methods employed in the construction of boilers. It is true this same public appears to object to any interference in the direction of seeing that boilers in use are kept in a safe condition, and attended by men who have some knowledge of their duties, but we believe no serious objection will be made by boiler users to some supervision in the matter before they get the boilers.

If an association of boiler manufacturers can bring about the proper use of the best material in boiler construction it will accomplish a good purpose. We say *proper* use, because ignorant or criminal construction is probably responsible for more disaster in the use of boilers than the quality of the material used. It may be a difficult matter to bring about the best methods of construction, for there are a good many boiler shops in which the work is done in a very crude way; but it is often, if not generally a fact, that crude methods of boiler-making cost more than approved methods, and this should have influence in working reformation. There ought to, it would seem, be but little trouble, if the most prominent boiler manufacturers will work together to that end, in securing the use of better material, and the employment of better methods in boiler construction.

As to the matter of price, it hardly seems probable that any association will ever be able to regulate that, unless the association is in the nature of a trust, which is something distinctly disavowed in the call referred to. In the first place, distance from raw material must have an influence on price, and again, a boiler manufacturer should have the right to give away a boiler, or to sell it at a price that affords a very small margin of profit, provided the boiler is a good one. There might be circumstances under which a man in the business of making boilers would find himself with the finished product on hand, which it was necessary for him to sell at a sacrifice or stop business. Boiler making is a business quite frequently entered upon with limited capital, and that capital must be turned over often, even occasionally at some sacrifice, in preference to keeping it locked up.

Then, again, the processes of boiler making are no more beyond improvement than are those of other mechanical processes, and if a boiler manufacturer improves his processes, he is entitled to the benefit of his improvement. To insist that he shall not sell below an arbitrary price is to do away with the incentive to improvement in the processes of manufacture; something that does not appear advisable. The instances are rare in which an effort has been made to establish a minimum price for a manufactured article, that there has not been trouble by at least the belief that some of the parties to the agreement were in some way evading it. If a strong association of boiler manufacturers can be formed—one that can control the kind of material used and the quality of the workmanship—it seems as if the price would take care of itself. It is true, as we have before this pointed out, that boilers are made and sold at a price that would scarcely pay for the right kind of material, to say nothing of labor; but this would be cured if pressure were brought to bear to compel the use of good stock and workmanship. No one is likely to follow the business of manufacturing boilers as a means of losing money.

A strong association of boiler manufacturers can not only do good in the way of securing the making of more good boilers, but it can educate the public up to a better understanding of the difference between a good and a poor boiler. There is great need of such education. To a great many buyers one boiler is as good as another of the same kind, and the question of price concludes the matter. A man who would discriminate to a nicety if he were buying a watch, seems totally to lack discrimination when buying a boiler. If he buys a poor watch, it will not kill his neighbor; if he gets a poor boiler it may.

We hope the call from Pittsburgh will result in an educational era in boiler making; it is quite time, and the opportunity is great.

Expert Testimony.

The recent remarks of Judge Bartlett, of the Supreme Court, on the subject of expert testimony, are exactly in line with what we said on the subject nearly two years ago. The distinguished jurist calls attention to the fact that it has come to be that juries have but little faith in such testimony, and his reasons for this are substantially the same we gave at the time noted, viz., an unconscious bias in favor of the party that pays the fees. At the time we previously referred to this subject we expressed the opinion that the only way to retain the advantages of expert testimony was to leave the appointment of experts to the court, the appointment being those entirely unprejudiced, and who, being under no obligation to either party in litigation, would give the court and justice the benefit of their knowledge and investigations. There is a world of difference between investigating a subject with the purpose of arriving at the truth, without interest as to what it shall be, and investigating the same subject to the end of establishing something that it is desirable from a partisan standpoint to establish. It is a question of bias, and not at all one of honesty. There are instances where it is practically impossible to establish the truth without the aid of expert testimony; but that the truth may prevail it is absolutely necessary that the person giving such testimony shall not in any sense be a party in the case.

Standard or Local Time.

A contest which has been going on between the Board of Education and the Council of an Ohio town, reminds us that one of the best things ever done by the railroads of the country was the adoption of standard time, and that it will be far better for all concerned when all cities and towns adopt it, thus making local and railroad time agree all over the land. But this contest shows how persistently men will sometimes fight for a thing which is absolutely non-essential, and which they would be much better off without, just because they have been accustomed to it. The Council of the town has passed an ordinance, under authority of which the entire Board of Education has been arrested for moving the hands of the town clock to make it show standard time.

There is no doubt that much inconvenience and bother would be done away with if the plan of having two entirely different times, as practiced in many places at present, could be abolished; and it seems to us that the opposition to the general adoption of standard time has very little foundation in reason. We have known manufacturing establishments to take a prominent part in contests over this matter, and believing, as we do, that they would be greatly benefited by the adoption of uniform time, we feel justified in speaking of the matter.

The opposition to the adoption of standard time seems to spring principally from the notion that some way there should be a distinct and unvarying relation between the position of the sun and the hands of clocks and watches; and that, unless the position of the sun indicates just noon when the clocks strike twelve, things will seem out of joint, and people won't know when to be hungry.

The extreme difference which can occur between standard and local mean time in any town is thirty minutes; and the vast majority of towns could adopt standard time by changing their clocks less than twenty-five minutes. It is safe to say that in one week after the change was made, not one person in a hundred could detect the difference; experience in the towns where the change has been made showing this to be the case. One of the principal reasons for this lies in a fact which is often overlooked by those who contend that true local time must be maintained, and that is, that clock or mean time agrees with sun or apparent time only occasionally, and for an instant, the sun at all other times being either faster or slower than clock time.

Taking the case of last year, for example, the sun agreed with clock time for an instant on three days of the year, *i. e.*, April 15, June 14, and December 24.

On February 11, of last year, the sun was 14 min. 28.8 sec. faster than clock time, from which date it became slower, until, on May 14, it was 3 min. 50.3 sec. slow. On July 25 it was 6 min. 15 sec. fast again, after which it fell behind, being, on November 2, 16 min. 20.8 sec. slow. Now this gives an extreme variation of the sun of 30 min. 49.6 sec., which is more than the change required in the clocks in any town, and far more than would be required in most towns to adopt standard time; yet it produces no evil effects, though it completely answers the argument of those who maintain that the sun must be in a certain part of the heavens at a certain time by the clock, or they can't be happy nor feel at home.

The fact is, that though at first thought we are apt to think a general change of time, one way or the other, to the extent of a few minutes, would upset things and produce confusion, it is really not noticeable unless special pains are taken to observe it, while the present plan of having two separate times, one differing from the other by from ten to twenty-five minutes, is the worst possible arrangement, and should be gotten rid of—the sooner the better.

Literary Notes.

A BRIEF HISTORY OF PATENT LEGISLATION in the United States. By D. Walter Brown, Ph. D., 128 Broadway, New York.

The author in this little pamphlet has presented in a small space a summary of American statutes relating to patents, from the Act of 1790 down to the revised statutes of 1874.

The information which the pamphlet contains is such as inventors and others interested in matters relating to patents will find of use. It is well printed and arranged. It can be had from the author, or from newsdealers. Price, 10 cents.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(148) J. T. H., New Wilmington, Pa., asks: Are there any portable railroads in successful operation? *A.*—Yes, they are frequently met with on sugar plantations.

(149) W. G. S., ———, asks: In using a pair of bevel gears, one being a mortise wheel, does it make any difference which one is the driver? *A.*—Under ordinary circumstances we do not think it makes any difference.

(150) W. B., ———, asks: If two taps of the same diameter are cut, one with four grooves and the other with three, will one cut larger than the other? *A.*—If that is the only difference between them, and they are used alike, they should tap holes of the same size.

(151) W. S., Hamilton, Canada, writes: Please give the size of a jet condenser and air pump for a marine engine with cylinders 14x15½ inches and 24x15½ inches. Boiler pressure, 80 pounds. B. says the condenser should be 11 inches by 3 feet, and the air pump 7x9 inches, but I think they are too small. *A.*—The capacity of the condenser varies from ¼ to ½ of the capacity of the low-pressure cylinder; generally ⅓ of the low-pressure cylinder capacity works well. If the condenser is 11 inches

diameter and 3 feet high, it will have ample capacity. The air pump seems to us to be small; we should make its capacity from ⅛ to 1-9 that of the low-pressure cylinder.

(152) C. A., Newark, N. J., writes: Will you kindly state the amount of weight which one cubic foot of air tank will buoy up in salt water, and also in fresh water? *A.*—It is evident that a tank one foot square and one foot high (outside measurement) will displace one cubic foot of water. One cubic foot of distilled water at 32° Fahrenheit, barometer 30 inches, will weigh 62.417 pounds; sea water will weigh 64.08 pounds. Hence, from the weight of one cubic foot of water subtract the sum of the weights of the tank and the air in it; the remainder will be the weight which the tank will buoy up.

(153) W. H. B., Blackstone, Mass., writes: I have an argument with an engineer in regards to the governor on the engine. The governor has two balls weighing about 15 pounds, and makes about 35 turns per minute. I claim that, if we make the balls weigh five pounds less, we can run it at a higher speed and hold the engine at the same speed. Who is right? *A.*—You are wrong. Decreasing the weight of the balls will affect their power of overcoming the friction in the various connections of the governor; a decrease or an increase of the weight of the balls, leaving friction out of account, will in no wise affect the speed of the engine. If you wish to increase the speed of the governor without changing the speed of the engine, you must shorten the governor arms.

(154) C. F. B., Philadelphia, Pa., asks: 1. What will be the effect of one quart of coal oil once a week in a Harrison boiler? *A.*—If you mean kerosene oil, the effect will be to remove the scale and keep the boiler clean; whether one quart is sufficient for the purpose we cannot say, as you do not give the size of boiler. 2. When a slide valve engine is on a dead center, and the eccentric is set at right angle to the crank, should the ports be covered, or open ⅜ of an inch, as I have seen it? *A.*—When the crank is on the dead center, the amount of opening should be equal to the lead. In general, ⅜ of an inch opening at the beginning of the stroke is too much lead for ordinary horizontal stationary engines. 3. What is the horse-power of an engine 18x24 inches; 220 revolutions; automatic cut-off; boiler pressure, 80 pounds? *A.*—270 I. H. P.

(155) W. R. B., Chatham, N. Y., asks: Will you please inform me the best way to fire a small model locomotive without the use of alcohol? I have tried charcoal, but I cannot get fire enough. The boiler is made of galvanized iron, No. 20 wire gauge; the fire-box and heads of copper of the same thickness as the shell; dimensions of boiler shell, 5 inches; fire-box, 6 inches high and 6 inches long, and 4½ inches wide, well braced and stayed; all seams are riveted; has seven flues ⅝ inch diameter, 11 inches long. What pressure would such a boiler stand? *A.*—It seems to us that, for the purpose of firing, a suitable kerosene lamp will answer very well. If the boiler is well made and stayed, it will carry a pressure of 50 pounds per square inch. But, on general principles, we should not advise to subject the boiler to anywhere near this pressure.

(156) W. M. A., Marshall, Texas, asks: What will be the capacity of a round tank 15 feet inside diameter, and 125 feet high? And what will be the pressure per square inch at bottom of tank when full of fresh water? *A.*—The area of a circle 15 feet diameter is 176.71 square feet; multiplying this area by the height in feet, we obtain its capacity in cubic feet; hence, $176.71 \times 125 = 22{,}088.75$ cubic feet. One cubic foot contains 7.48 gallons, consequently, the tank will hold $22{,}088.75 \times 7.48 = 165{,}223.85$ gallons. In mechanics, it is proved that the pressure against an elementary area equals the weight of a prism of the liquid whose base is the area pressed, and whose altitude is the vertical distance of the area below the free surface. This law holds good for the pressure against the sides as well as for the pressure against the bottom. Consequently, the pressure per square inch on the bottom of the tank is equal to the weight of a column of water one inch square and 125 feet high. A column of water one inch square and one foot high weighs .434 pounds; hence, the pressure per square inch on the bottom of the tank will be $125 \times .434 = 54.25$ pounds.

(157) E. R. H., Oakland, Me., writes: I have a compound engine with cylinders 3¼ and 5″ diameter x 4 inches stroke; steam is cut off at 5-9 of the stroke in the H. P. cylinder, and at 7-9 in the L. P. cylinder; boiler pressure 100 pounds. How many feet of 1¼ inch pipe will it take for a surface condenser? *A.*—40 feet. We believe you will obtain better results by making the pipes ¾ inch diameter instead of 1¼ inch; of course, if you adopted the ¾-inch pipe, the number of lineal feet will have to be increased proportionately. 2. What will be the best thing which I can use in place of an air pump? The engine will make about 300 revolutions per minute. Is there not something similar to an injector that can be used? *A.*—Yes; Korting Exhaust Steam Induction Condenser, or similar devices; the former has been illustrated in our issues of June 30, 1883; May 7, 1884. 3. If an air pump is recommended, what should be its size? *A.*—If you decide to use a single acting air pump, make its capacity equal to ⅛ to 1-9 of the capacity of the L. P. cylinder. 4. We have an ordinary screw press for forcing couplings on the shafts. Can the pressure of the couplings on the shafts be increased by adding two more screws next to the one now in use? *A.*—Yes; provided you do not change the amount of force applied to the screw at present in use.

(158) G. & E., Newark, N. J., asks: What amount of horse-power is required to run 100 feet of 1 15-16 inch shafting when properly hung in line with the requisite number of hangers, say 6 feet centers? What additional amount of horse-power will there be required when there are, say, 40 pulleys added to the shaft? Belts on the loose pulleys; average width of belts 3 inches. *A.*—To simplify matters it will be best first to assume that all the belts are taken off, and then find the horse-power required to run the shafting and pulleys alone. For finding the horse-power required to run the shaft and pulleys at a uniform velocity, we have the following formula:

$$H.\ P. = \frac{p\ f\ v}{33{,}000}$$

Here, p represents the total pressure of the journals against their bearings; and since we have thrown the belts out of consideration, this pressure p is equal to the sum of the weights of the shaft and pulleys; f represents the coefficient of friction, and we shall assume it to be equal to .05, that is to say, for every pound of the pressure the friction is 5-100 of a pound; v is the velocity of the rubbing surface in feet per minute; this velocity v is found by multiplying the circumference of the journal in feet by the number of revolutions per minute. The number of revolutions has not been given in the question, neither has the weight of the pulleys been given; for the sake of illustration, we shall assume that the shaft is to make 150 revolutions per minute and the total weight of the shaft and pulleys equal to 1,500 pounds. The circumference of a shaft 1 15-16 inch diameter is 6.08+ inches, say ½ foot; the velocity in feet per minute of the surface of the journal will be $150 \times .5 = 75$ feet per minute. Putting these values in the place of the letters in the formula we have

$$H.\ P. = \frac{1{,}500 \times .05 \times 75}{33{,}000} = 0.17+,$$

or a little over 1-6 of a horse-power. The same method is adopted for finding the horse-power when 40 pulleys are added; thus, for instance, let the weight of these pulleys be equal to 4,000 pounds, then the total weight of shaft and pulleys will be $1{,}500 + 4{,}000 = 5{,}500$ pounds, and the horse-power required to run the shaft with these pulleys at a speed of 150 revolutions per minute will be

$$\frac{5{,}500 \times .05 \times 75}{33{,}000} = 0.62+.$$

The difference between this amount of horse-power and that previously found, namely $.62 - .17 = .45$, is the additional horse-power required for running the shaft with the extra 40 pulleys of the assumed weight. When the belts are taken into account, we use the same formula for determining the horse-power; but in this case it must be remembered that the pressure p of the journals against their bearings is equal to the weight of the shaft and pulleys, plus the algebraic sum of the vertical tensions of the belts; that is to say, the downward tension of the belts should be added to the weight of the shaft, and the upward tension of the belts should be subtracted from it. For belts running at an angle we must find the resultant of the forces represented by the weight of the shaft and the tensions of the belts; this resultant will be the pressure. It may also be added that it is a difficult matter to choose the exact coefficient of friction, as there are several items which may change it considerably. Our coefficient of friction, .05, will probably be not far out of the way for line shafting not subjected to an excessive pressure, and its journals kept well lubricated.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue

Gear wheels and g-cutting. Grant, see adv., p. 16.
Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.
Upright Drills. J. E. Snyder, Worcester, Mass.
Upright Drills. J. E. Snyder, Worcester, Mass.
Upright Drills. J. E. Snyder, Worcester, Mass.
Upright Drills. J. E. Snyder, Worcester, Mass.
Colliau Cupolas, etc. A. E. Jenkins, Scranton, Pa
Special tool work. R. M. Clough, Meriden, Conn.
Shafting Straighteners. J. H. Wells, Tampa, Fla.
Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.
The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.
Berryman Feed-Water Heater and Purifier. Benj. F. Kelley, 91 Liberty street, New York.
R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.
Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.
"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.
Power measured with guaranteed Dynamometers, Franklin Van Winkle, 91 Liberty st., New York.
Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.
"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.
"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.
Round Adjustable, Round Solid, and Square Dies, all sizes. Mfd. by S. W. Card & Co., Mansfield, Mass.
Fire Brick and Clay Retorts for all kinds of heating and melting furnaces. Borgner & O'Brien, Phila.
Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.
"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N. Y.
Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.
Best silk wiping towels for machinery in the market. S. A. Smith, 23 S. Canal st., Chicago, Ill.
For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.
Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.
Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.
Buy the best Upright Drill; finely made, great capacity and quickly operated. 20″, 21″, 23″, 25″, 28″, 32″, 36″ swing. J. E. Snyder, Worcester, Mass.
See Illustration of Portable Key-Seating Machine on page 3, this issue. For further particulars address T. C. Dill Mach. Co., 726 Girard av., Phila., Pa.
"Curiosities of the U. S. Patent Office." A great book. Goes like hot cakes. 12 pp. pamphlet for stamp. *Get one.* W. C. Raymond, Syracuse, N. Y.
Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.
The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.
W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.
Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.
The Vance Lightning Flue Cutter is *the* tool for removing old flues from boilers and locomotives (will cut fifty an hour); sent on approval to railroad companies. Vance Tube Cutter Co., Geneva, N. Y.
Standard Drawings of Improved Corliss Engines; Non-Condensing, Condensing, Compound and Triple Expansion. New Valve Gear and Dash Pot; also all branches Mechanical Engineering. Conover & Co., 219 Market st., Newark, N. J.
Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages illustrated. 12mo., cloth, $2.00. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.
For Reflecting or Refracting Telescopes, Spectroscopes, Object Glasses, Specula, Polarizing Eye Pieces, Heliostats or any apparatus for Astronomical Photography or Observation, address J. A. Brashear, Allegheny, Pa. We furnish Specula or Objectives, or any accessories with drawings, so that mechanics and amateur astronomers can mount their own telescopes.
"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor place, New York.
"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.
"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including March 14, 1889 issue, 72 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.
"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 87 articles have thus far appeared up to and including the March 21, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

Joseph Varney will build a large saw mill at North Bath, Me.

P. W. Lownes is starting a jobbing machine shop at Orlando, Fla.

George O. Goodwin will build a steam saw mill at Mechanic Falls, Me.

Long & Jervis propose building a foundry and pump works at Decatur, Ala.

The American Hosiery Co., New Britain, Conn., will build an addition to its works.

The Ajax Forge Company, Chicago, Ill., has increased its capital stock by $150,000.

The Burlington & Missouri River Railroad expects to build extensive shops at McCook, Neb.

The Kemp's Creek (Ala.) Lumber Company will build a saw mill, a planing mill, and a grist mill.

Citizens of Marshall, Minn., agree to subscribe to the stock of a company that will build a flour mill there.

The Watertown Machine Company has been incorporated at Watertown, Wis.; capital stock, $60,000.

The Iowa Barbed Wire Company, of Allentown, Pa., will build a mill for rolling rods from four-inch steel billets.

The Eagle Iron Works, Des Moines, Iowa, are making improvements to accommodate their engine and boiler trade.

The extensive car and paint shops of the Central Railroad of New Jersey, at Ashley, Pa., were recently destroyed by fire.

The Eufaula (Ala.) Cotton-Seed Oil Mills and Guano Factory Company has been organized, and a mill will be built at once.

The Virginia & North Carolina Wheel Co., Richmond, Va., has voted to increase its capital stock to $100,000, and enlarge its works.

The Nashua Card and Glazed Paper Co. is building works at Nashua, N. H. The buildings will have a front on Franklin street of 315 feet.

The Stilwell & Bierce Mfg. Co, Dayton, Ohio, has engaged in the manufacture of mining machinery under the patents of W. H. H. Bowers.

The machine works of McIntosh & Hemphill, Pittsburgh, Pa., were recently destroyed by fire, believed to have been of incendiary origin.

The Robert Aitchison Perforated Metal Co., Chicago, Ill., has recently made shipments of their product to South Australia and to Honduras.

The Venetian Blind Co., Burlington, Vt., is doing a largely increased business. Recent additions to the works are found inadequate, and further additions will be made.

Hilles & Jones, Wilmington, Del., have lately built several of their large size vertical milling machines for The Maxim Nordenfelt Guns & Ammunition Co., Limited, London, England.

W. W. Oliver, Buffalo, N. Y., has issued a new catalogue and price list of jewelers' tools and supplies. He makes a large variety of such tools, which are illustrated and described in the catalogue.

The St. Louis Wooden Ware Company, of St. Louis, Mo., has leased eight acres of land in West Memphis, Tenn., on which wooden ware works will be erected. It is said $175,000 will be invested, and that about 200 men will be employed.

The Robinson Woolen Company, South Windham, Me, has its new mill well along, and expects to have it finished early this spring. It is a brick building, 120x53, and to be four stories. The company will also build a brick picker-house later, 40x40, and two stories. The new mill will be fitted up with improved machinery.

Gould & Eberhardt, Newark, N. J., have been awarded a contract by the Navy Department for one of their entirely automatic gear cutters. They inform us that, notwithstanding there were several competitors in the field, they received the contract, although third from the lowest in price.

There is water-works agitation at Winchester, Ky.; Greenville, Miss., Meridian, Miss.; Orangeburg, S. C.; El Paso, Texas; Sterling, Ky.; Rochester, N. Y.; Muskegon, Mich.; Tullahoma, Tenn.; Collinsville, Ill.; Delphi, Ind.; Boothbay Harbor, Me. Weymouth, Mass.; Toronto, Ont.; Georgetown, Ky.; North Adams, Mass.

The Chester Steel Castings Co., who have their office at 407 Library street, Philadelphia, are erecting a brick addition to their works, 60x150 feet, in which will be placed two converters for making steel by the new French process, which has been improved by, and is being introduced into this country by J. W. Bookwalter of Springfield, Ohio.

The works of the Novelty Steel Wheel Company will be located at Bissell, Pa., and will be 50x200 feet, two stories high, iron-clad. The following officers were elected at a recent meeting of the company: W. W. Achison, of Pittsburgh; vice-president, Wm. O'Bryon, of McKeesport; secretary, Joseph Painter, of Kittanning; treasurer, James L. D. Long, of McKeesport; superintendent, John McGeorge, of Washington.

We are in receipt of the 1889 catalogue of Hilles & Jones, Del. It is a large bound volume of nearly 200 pages, containing cuts and description of tools built at the works. This firm build a great variety of machines for boiler makers, bridge builders—in fact, for all heavy plate working, and they are very well illustrated in this catalogue, which is printed on heavy paper.

E. E. Garvin & Co., New York, make the following announcement: "We have the pleasure of notifying our customers and friends that we have secured a long lease of the new building at Laight and Canal streets, and shall take possession about April 1st. Our new quarters contain about 45,000 square feet of floor room, and has light on three sides. We therefore shall have increased facilities for manufacturing and executing any orders that we may be favored with. Our plant will be a modern one, and all necessary tools for the proper and expeditious finishing of work will be introduced as fast as required.

Youngstown [Ohio] capitalists have practically concluded arrangements for the building of an extensive bridge works in the suburbs of Haselton on or near the site occupied by the Morse Bridge Works, which were destroyed by fire. The organization will be known as the Youngstown Bridge Company, with a capital stock of $100,000, all of which has been subscribed. Application has been made for a charter. The incorporators are B. F. Boyd, Hamilton Harris, Robert Hunter, L. E Cochran and John Neilson. The company expects to be in operation in three months, and employ 100 men.—*American Manufacturer.*

A late invention for the use of sawmills, called the rosser, or log siding machine, removes the bark and the outer slab from a log, forming a cant of the required dimension without the use of a circular, and is regarded by those who have used it as a valuable device. The log is passed through a set of revolving wheels with a series of knives which grind off the outer slab upon the log, and it passes thence directly to the gang or circular, to be cut as required. It leaves no slabs, as the entire amount which would in the old process form slabs and thin boards is ground up by these knives. The principal advantage claimed for it is the great saving of time. One is now being put into the Sawyer-Goodman Company's mill at Menominee, Mich.—*Saginaw Herald.*

Machinists' Supplies and Iron.

NEW YORK, March 30, 1889.

Iron—American Pig.—The demand for finished iron shows some indication of improvement, though as yet this seems not to have affected the Pig Iron market. We quote No. 1 X Foundry, $17 to $18; Lehigh and North River brands, $17.50 to $18; No. 2 X Foundry, $16 to $17; Grey Forge, $15 to $15.50.

Scotch Pig.—We quote Coltness, $21 to $21.50; Gartsherrie, $20; Summerlee, $20.50; Eglinton, $19 to $19.25; Dalmellington, $19.75 to $20; Clyde, $20.50, and Langloan $20.50.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—See bottom of third column, page 11.

A 1 draftsman. Who wants him? Address A., care AMERICAN MACHINIST.

Wanted—Situation as foreman by practical machinist & draftsman; best refs. A.D., AM. MACHINIST.

Wanted—Good man on steel rules; must be experienced and thoroughly competent. Address Box 84, AMERICAN MACHINIST.

Experienced foundry foreman desires a position. Engine work preferred; highest references. Address BOX 85, AMERICAN MACHINIST.

Experienced and educated mech. draftsman, conversant with engine and general mach. work, wants position. Address B., AMERICAN MACHINIST.

Foundry Foreman—A young man understanding moulding and management of foundry desires position as foreman. Address F. F., care AM. MACHINIST.

Wanted—Machinist with experience at setting up cylinder printing presses. Address, stating age, previous employment, and references, Golding & Co., 183 Fort Hill sq., Boston.

Wanted—A first-class moulder, competent to superintend a foundry. Must have $5,000; a good salary will be paid to a first-class man. Address Box 78, AMERICAN MACHINIST.

A corporation manufacturing specialties desires a foreman; must be a thorough machinist, and must have a small amount of capital. Address Manufacturers, Box 316, Buffalo, N. Y.

Situation wanted by a first-class machinist of 15 years' experience as assistant mech. draftsman, or any other position where he can work his way up. Address E. L., AMERICAN MACHINIST.

Wanted—A good machinist to contract to erect engines in quantities, also another to do the tool work on same by contract. For further information address Box 80, AMERICAN MACHINIST.

Wanted—Mechanical draftsman and designer, familiar with the latest designs of marine engines and boilers; state age, nativity, and salary expected. Address Marine Designer, care AMERICAN MACHINIST.

Wanted—Superintendent to take charge of a wood-working machinery manufactory; must be versed in designing, pattern making, and understand the handling of men. Address Indiana Machine Works, Fort Wayne, Ind.

Wanted—For a good permanent position, a good man thoroughly experienced in the different branches of fine machine work and tool making; one having knowledge of drafting preferred. Address, stating age, &c., F. A. Hunter, 129 4th St., Detroit, Mich.

Wanted—Position as mech. draftsman or assistant to same by tech. grad.; 8 years' exp. in drawing room and shop on variety of work, principally mach. tools. Especially qualified to start up and run a drafting office with system and economy. Best references. Q. E. D., AMERICAN MACHINIST.

A thoroughly responsible first-class machinist and engineer will be open for engagement April 15. Have held present position as machinist and chief engineer for four years. Unquestionable refs. from present and past employers; correspondence solicited; satisfaction guaranteed. Chief Engineer, AM. MACHINIST.

Wanted—A situation as foreman machinist; 15 years' experience on mill machinery, Corliss and other automatic, marine and locomotive engines; also experience in drafting, designing, use of the indicator and computation of diagrams; well up in modern shop practice. Address L. C. P., 392 Scribner st., Grand Rapids, Mich.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Gerlach's Engineers' specialties beat the world. Send for price list. Crescent Mfg. Co., Cleveland, O.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Wanted—Iron planer, 2d-hand, 6 or 7 ft. bed. Give description & price. Edwin Clifton, Camden, Ark.

For Sale—Second-hand 72" mill for boring only; good order. A Garvin tapping machine, new. A. L. Henderer, Wilmington, Del.

Wanted—To rent or buy machine shop in a good locality; tools must be in good order. Address Box 86, AMERICAN MACHINIST.

Pattern makers should send to W. H. Denney, Lancaster, Pa., for circular of Self-adjusting Handscrews. Saves time and labor.

An original and sure receipt for tempering and making Fine Drills. Two-cent stamp for terms. I. H. Bartholomew, Northford, Conn.

For Sale—2nd-hand engine 16x36 in., 12 foot band wheel & Judson governor, all in good repair, $300. Geo. Strecker & Co., Marietta, Ohio.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Thos. Ordish, 1723 S. 7th st., Phila., Pa.

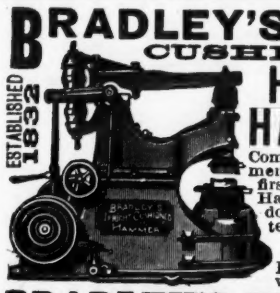
Wanted—Parties selling to steam users and supply houses to handle some good selling specialties on commission. Manufacturer, AMERICAN MACHINIST.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

Wanted—One or two first-class machinists with about $3,000, to engage with party having same amount of money, in the manufacture of Iron Planers. Only those wanted having practical experience in building these machines. None others need apply. New Design, care AMERICAN MACHINIST.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



ESTABLISHED 1832

Combines the best elements essential in a first-class **Hammer**. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the world.

BRADLEY'S HEATING FORGES.

ESTABLISHED 1832

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements. For hard coal or coke. Indispensable in all shops to keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.

Pat. Aug. 30, 1887.

BRADLEY & CO. SYRACUSE, N. Y.

98 Sudbury St., Boston, Mass.
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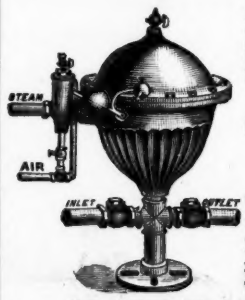

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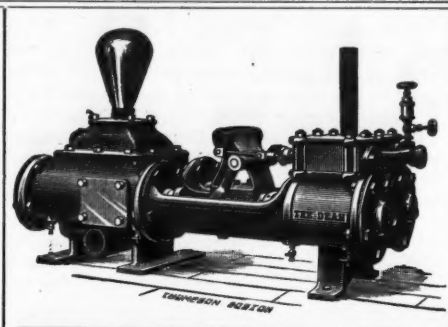

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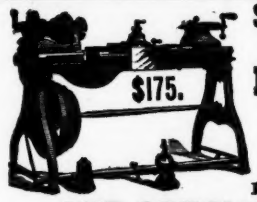

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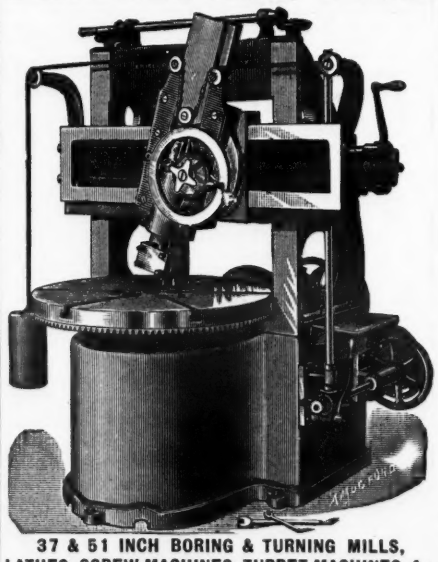

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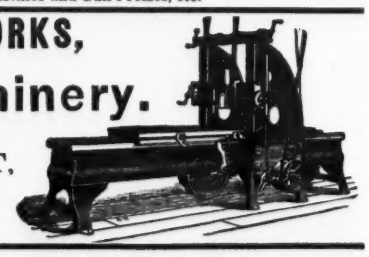

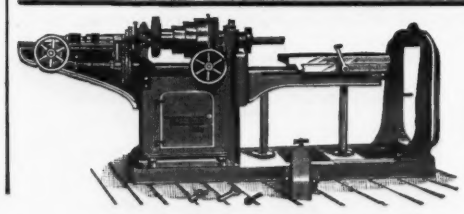

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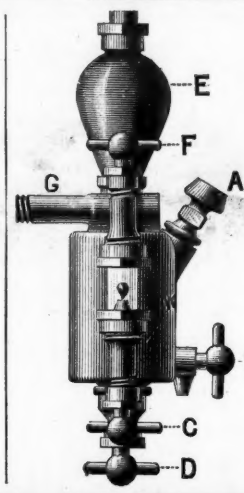

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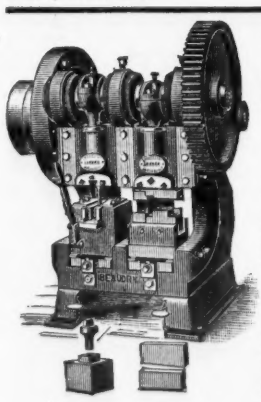

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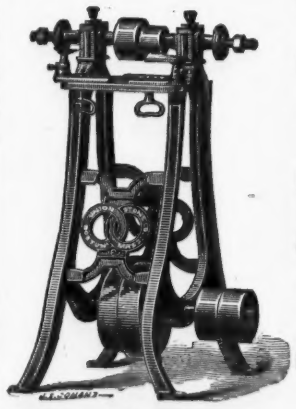

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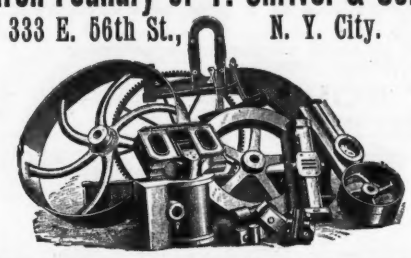

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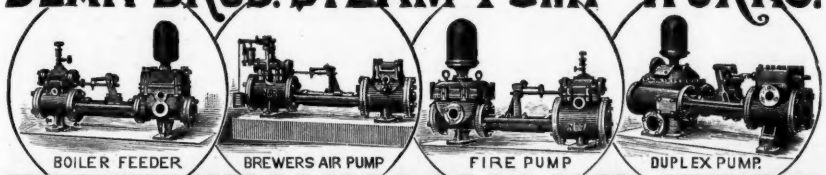

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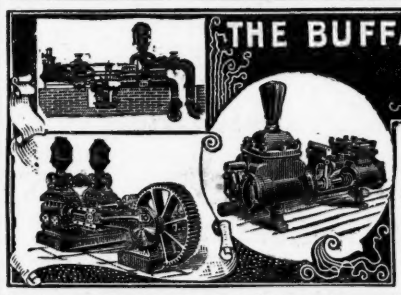

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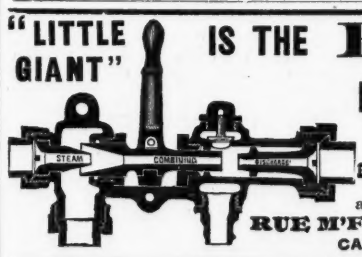

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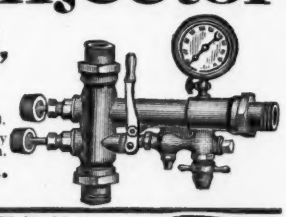

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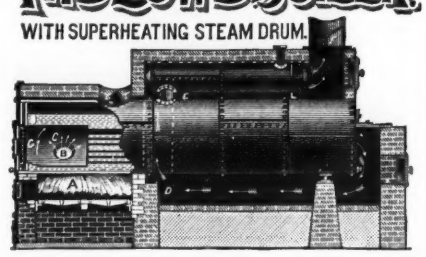

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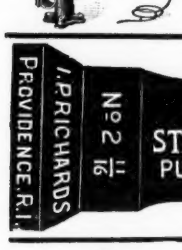

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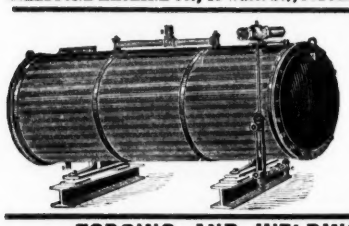

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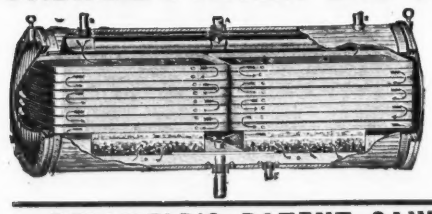

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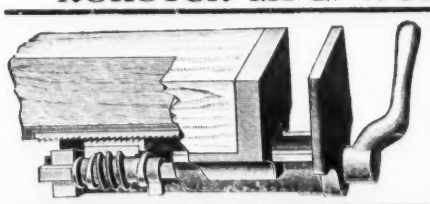

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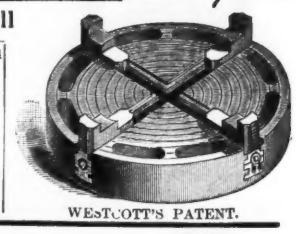

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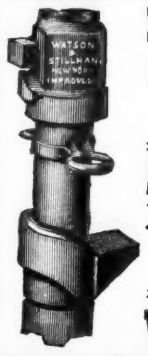

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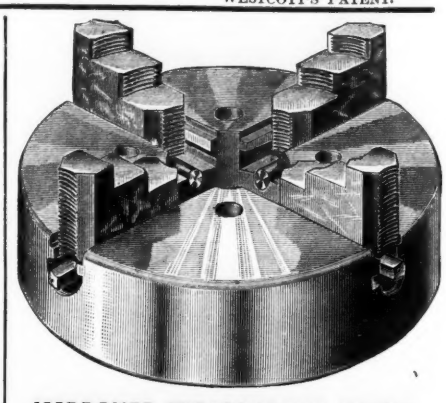

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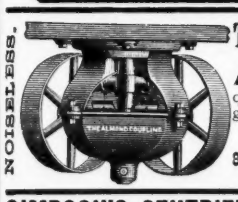

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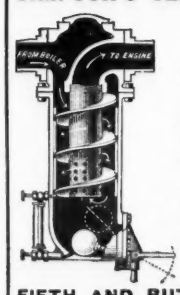

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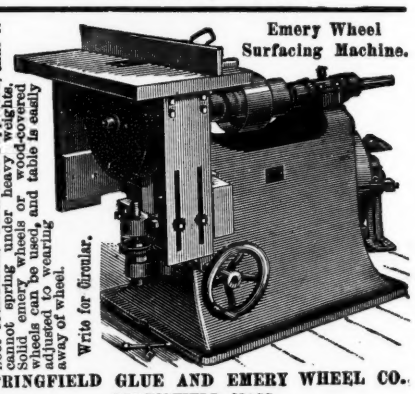

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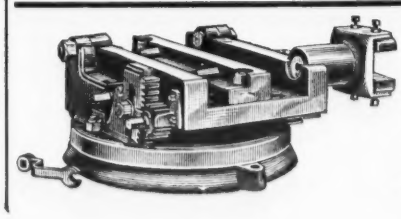

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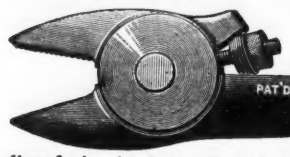

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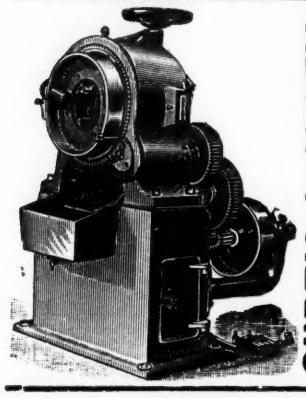

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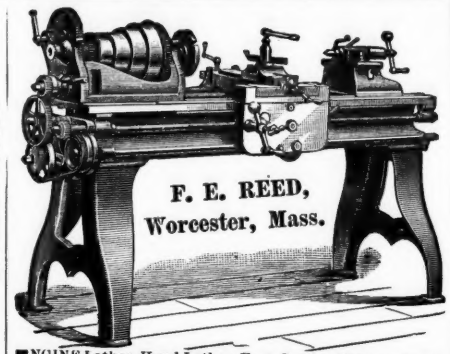

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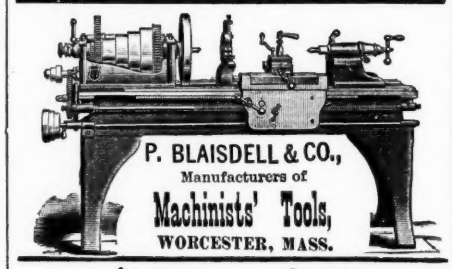

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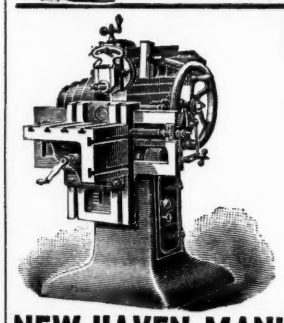

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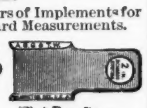

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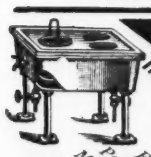

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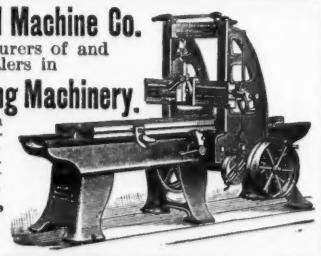

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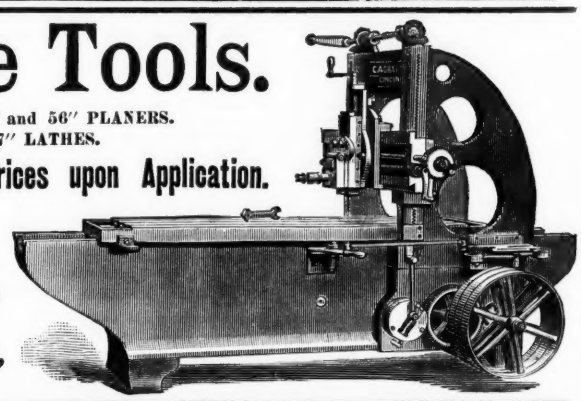

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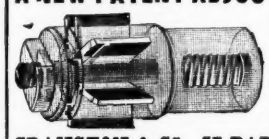

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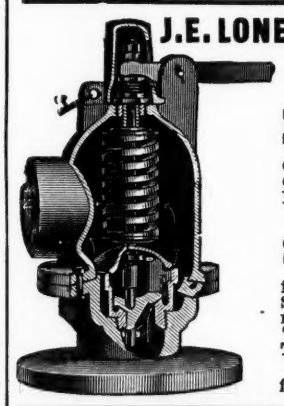

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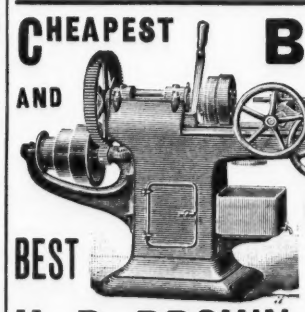

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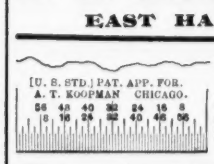

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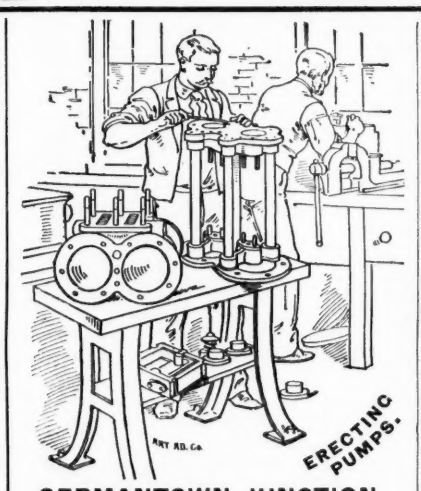

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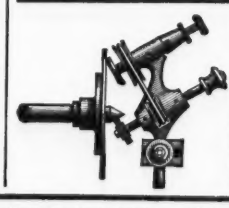

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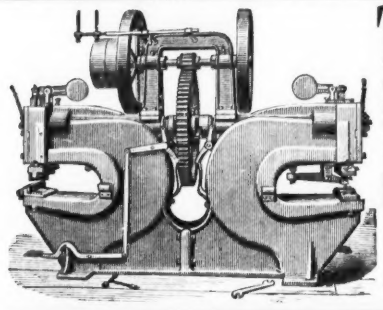

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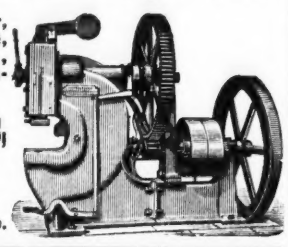

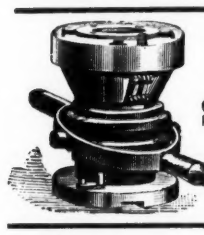

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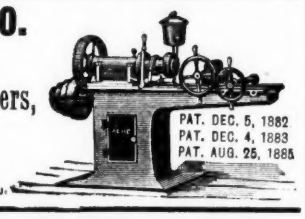

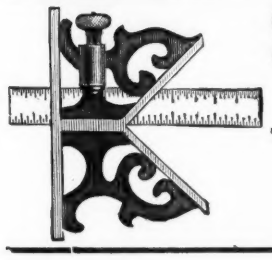

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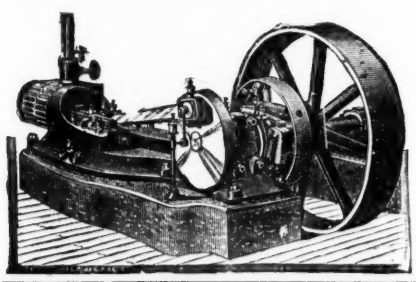

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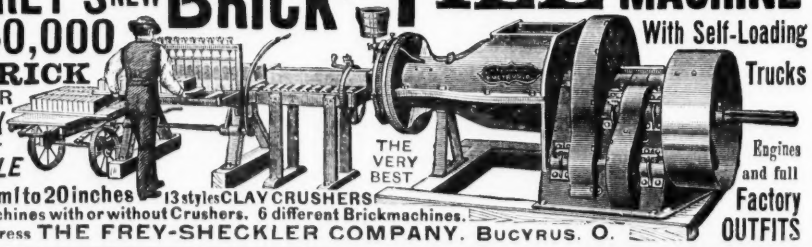

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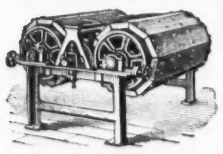

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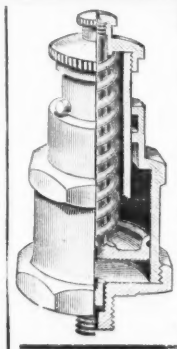

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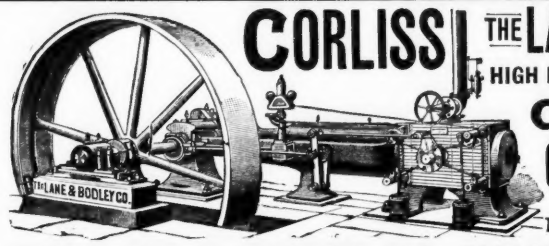

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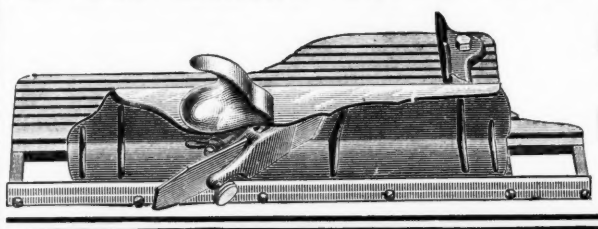

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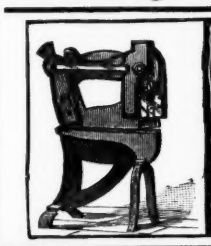

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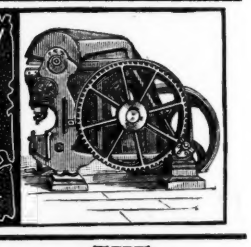

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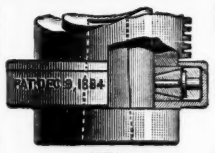

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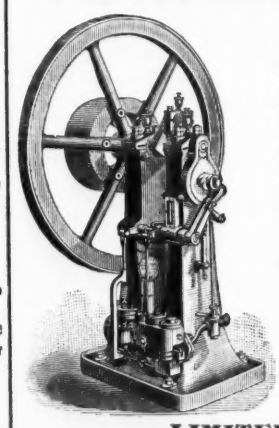

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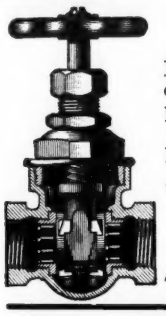

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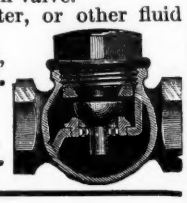

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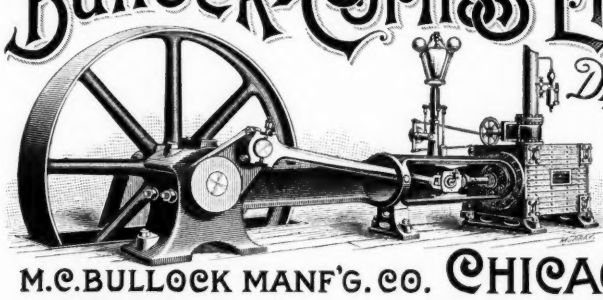

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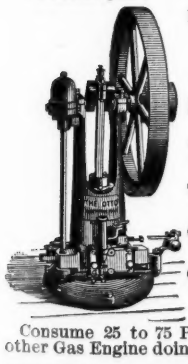

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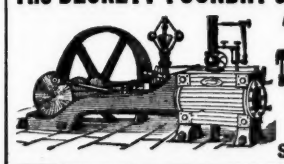

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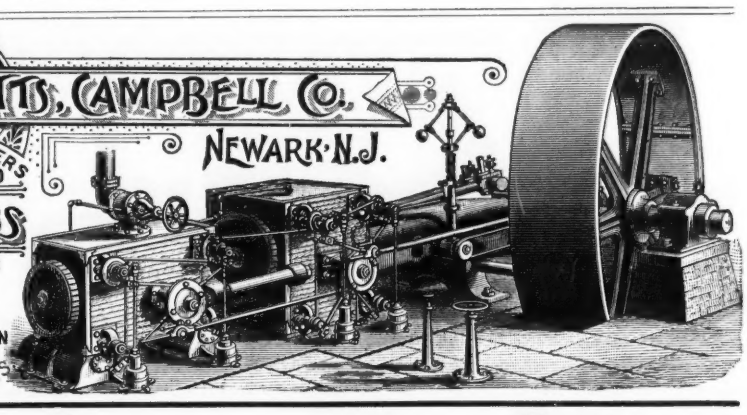

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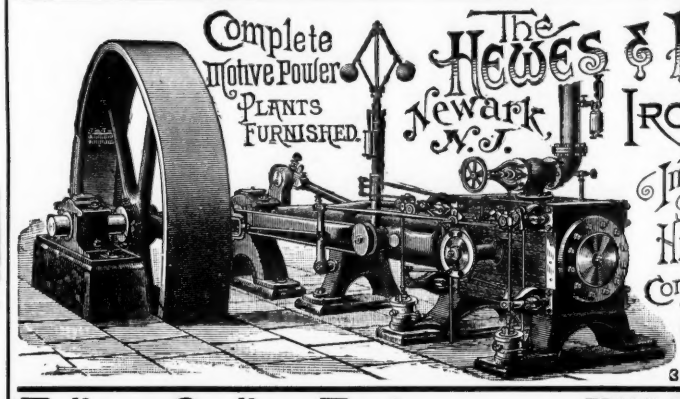

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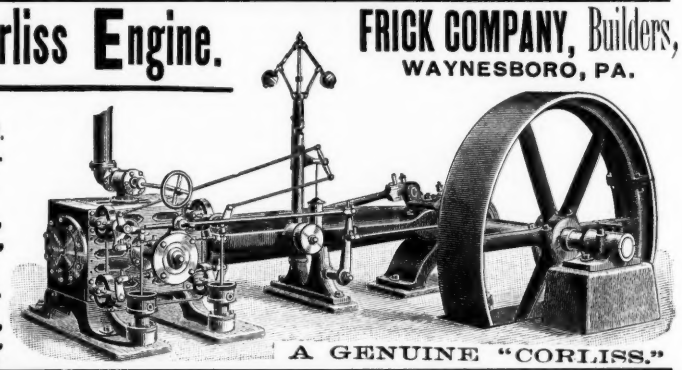

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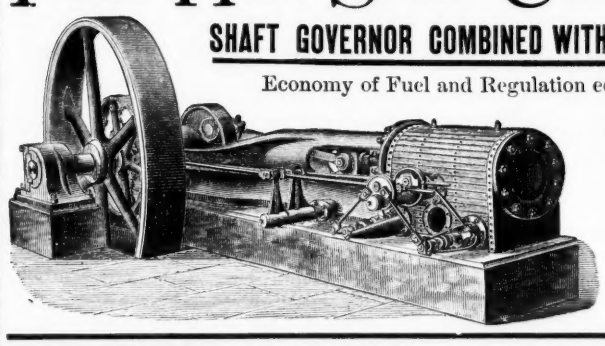

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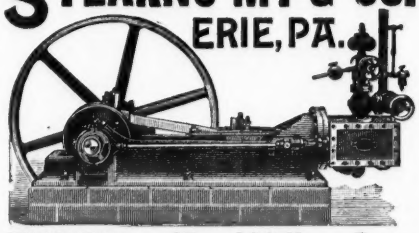

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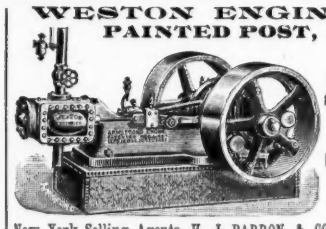

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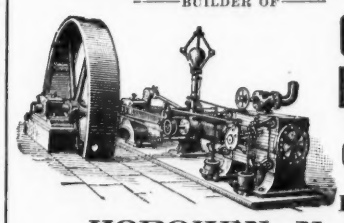

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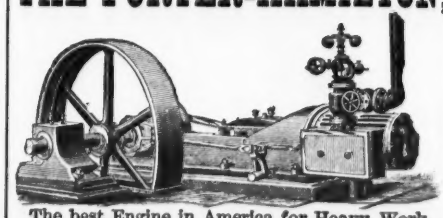

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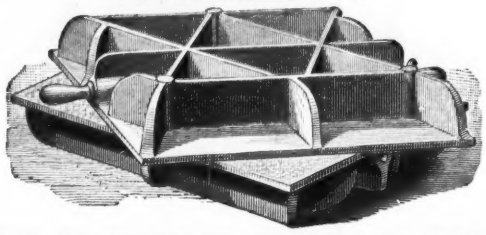

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3½ × 12″	weight,	11 lbs.	9 × 9″	weight,	16 lbs.	18 × 18″	weight,	65 lbs.
4½ × 6″	"	5 "	9 × 14″	"	27 "	18 × 24″	"	128 "
6 × 6″	"	7 "	10 × 15″	"	35 "	18 × 36″	"	228 "
6 × 12″	"	19 "	10 × 30′	"	99 "	20 × 78″	"	813 "
6 × 50″	"	120 "	12 × 12″	"	29 "	24 × 24′	"	164 "
6½ × 18″	"	30 "	12 × 18″	"	53 "	24 × 36″	"	298 "
7 × 7½″	"	11 "	14 × 14″	"	47 "	24 × 48″	"	442 "
7 × 10″	"	15 "	14 × 18″	"	62 "	24 × 60″	"	666 "
8 × 12″	"	21 "	16 × 16″	"	62 "	36 × 68″	"	1024 "

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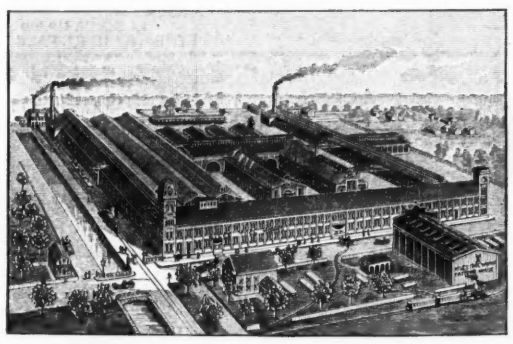

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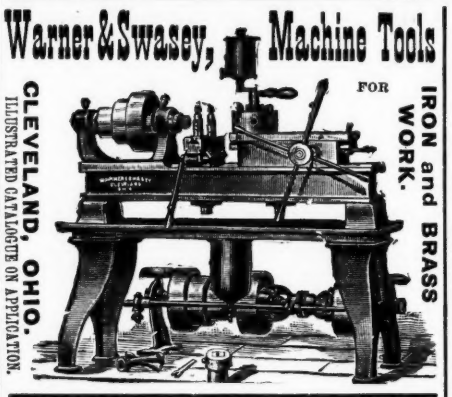

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A machine shop 500′ long by 100′ wide; a foundry 250′ long by 90′ wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

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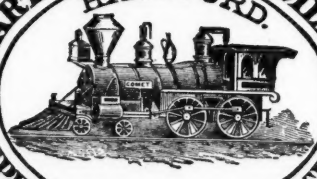

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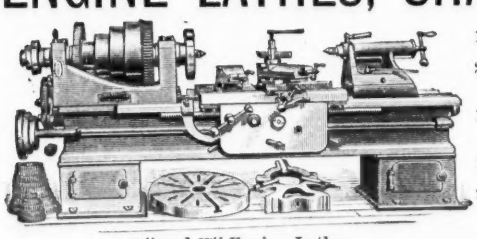

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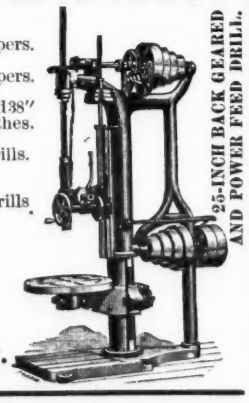

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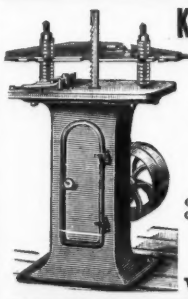

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More **economical** than any we have ever used.
Can do **double** the work. Most convenient.
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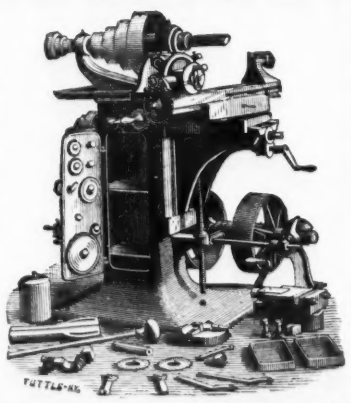

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